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CONTENTS

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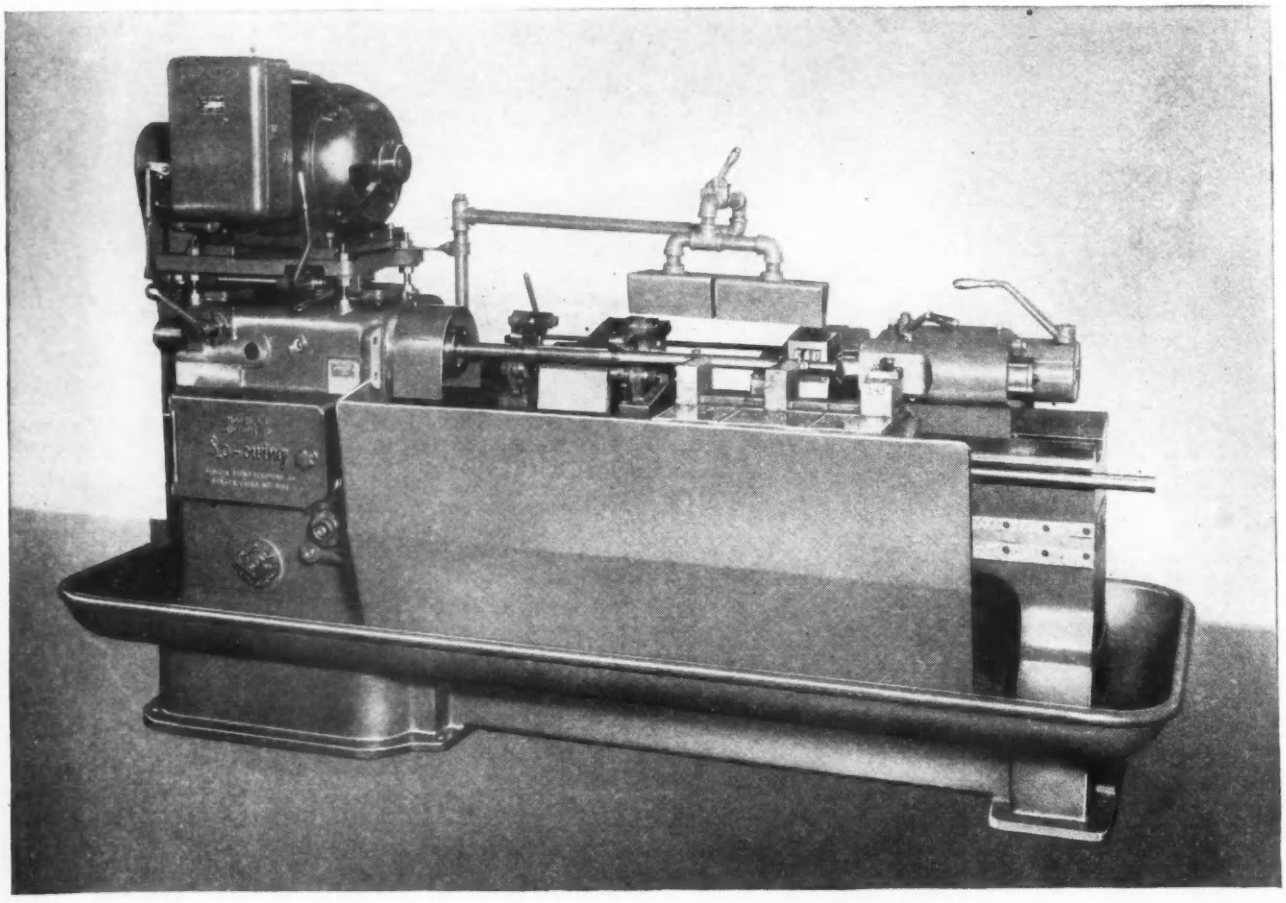
MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YORK

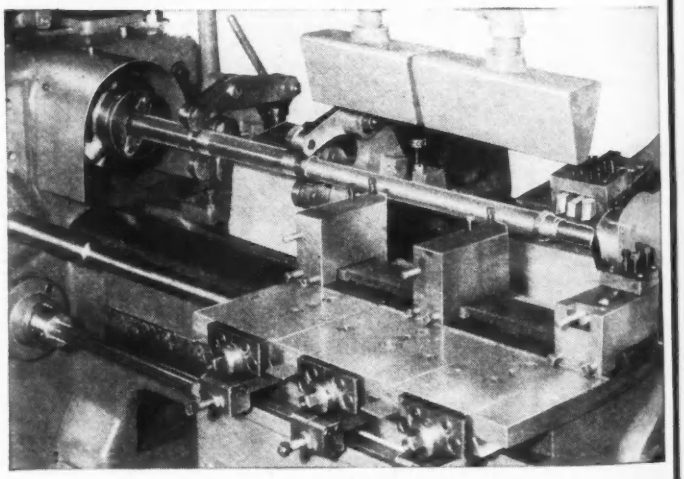


MODEL LR *Lo-swing* LATHE EQUIPPED FOR TURNING LONG, SLENDER SHAFTS

Problem: **To provide a fully automatic Lathe capable of turning long, slender tubes with sintered carbide tools.**

Solution: **In order to reduce the number of tools in contact with the work to a minimum and thus avoid distortion of the tube, this job required a machine with a specially long carriage feed.**

A Model LR Lo-swing was selected for this job and equipped with a special longitudinal feed attachment permitting a maximum carriage travel of 9" which was in excess of that required for this job. The tube is held between centers and driven with a Seneca Falls Automatic Driver which assures a positive balanced drive and also prevents distortion. The work is supported with two-roller steady rests, the rolls of which are in contact with two ground spottings. One-half of the shaft is turned as shown in illustration, after which the shaft is reversed and the opposite end turned.



Another feature of this machine is the three slide carriage having independently cam-controlled slides operated through the Seneca Falls SIMPLIFIED CHANGE-OVER MECHANISM. Each slide may be set for different lengths of cuts by a simple adjustment of gear segments which are fitted with graduated scales corresponding to desired length of cut in inches.

The Model LR Lo-swing Lathe is completely automatic; the operator simply loads and unloads the work and pulls the starting handle.

LATHE NEWS of SENECA FALLS

AUTOMOTIVE and AVIATION INDUSTRIES

Published on the first and 15th of the month

August 1, 1946
Volume 95, No. 3

Labor's Stake in Freedom

By J. Howard Pew
President, Sun Oil Co.

THOSE of us who through many long years have championed freedom of expression for all groups hold that fair and truthful comment regarding the activities of those participating in public affairs is right and proper. But the spreading of falsehood and distortion is another matter.

Too much discussion of the serious problems facing our nation these days is devoted to scurrilous attacks designed to impeach the motives of those who disagree with the speaker. It is the fashion for certain self-styled "liberals" to seek followings among the unthinking by attacks on men in business and industry consisting largely of innuendoes, distortions, half-truths and just plain lies. This is conspicuously true of those many and frequent attacks on industry and business leaders which have been made, particularly since the beginning of the New Deal, by labor agitators generally, by pink-tinted bureaucrats, and even by certain past and present governmental officials of extraordinarily high rank.

Those who honor truth can easily establish within the region of intelligent comprehension that the basic philosophy of the real leaders of business and industry is wholesome, simple and fundamentally American. The first article in their creed is an expression of the firm belief that what is good for the country as a whole is best for themselves individually. Thoughts to the contrary are as old fashioned as Noah's Ark and as unsound and as insidiously destructive as the spotted apple that lies at the bottom of the barrel.

It is the belief of real business leaders that business and industry render their greatest service to the Nation when they constantly produce better commodities and services at lower prices through an efficiency that reconciles a low cost policy with the payment of high wages. They believe that continued prosperity demands the maintenance of broad-based buying power such as can be assured only by a general program of liberal wages and salaries.

They have fought governmental control in peacetime because they know it leads to totalitarianism. They have opposed, by word and deed, such proposals involving restraint of trade as N.R.A. They have opposed international cartels. They have fought against price control because they regard it as an economic evil from the viewpoint of the general welfare. They know that rising prices are not the cause but one of the many disastrous results that follow in the wake of inflation.

The inflationary condition we have today is primarily a result of 15 years of government spending in excess of income and the issuance of bonds and printing press greenbacks to pay the debt. On top of this we have war-accumulated shortages in certain consumer goods, aggravated by OPA controls. Prices will continue to rise so long as we continue to do these things, OPA or no OPA!

Throughout all history price control schemes, wherever they have been tried, have brought disaster in their wake. Price controls in peacetime cannot be made to work without increasingly severe, additional restrictions, thus eventually

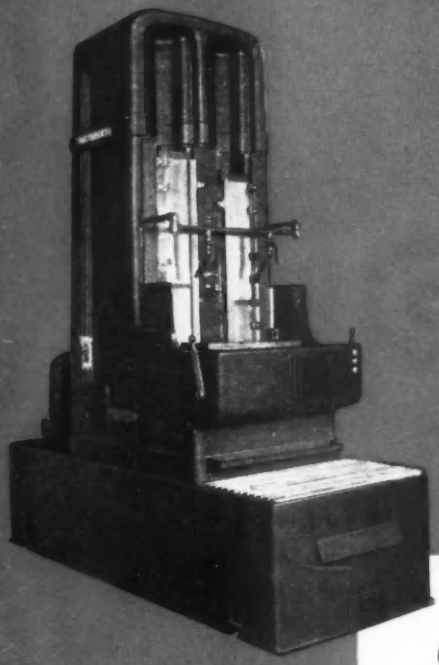
(*Turn to page 56, please*)

CINCINNATI

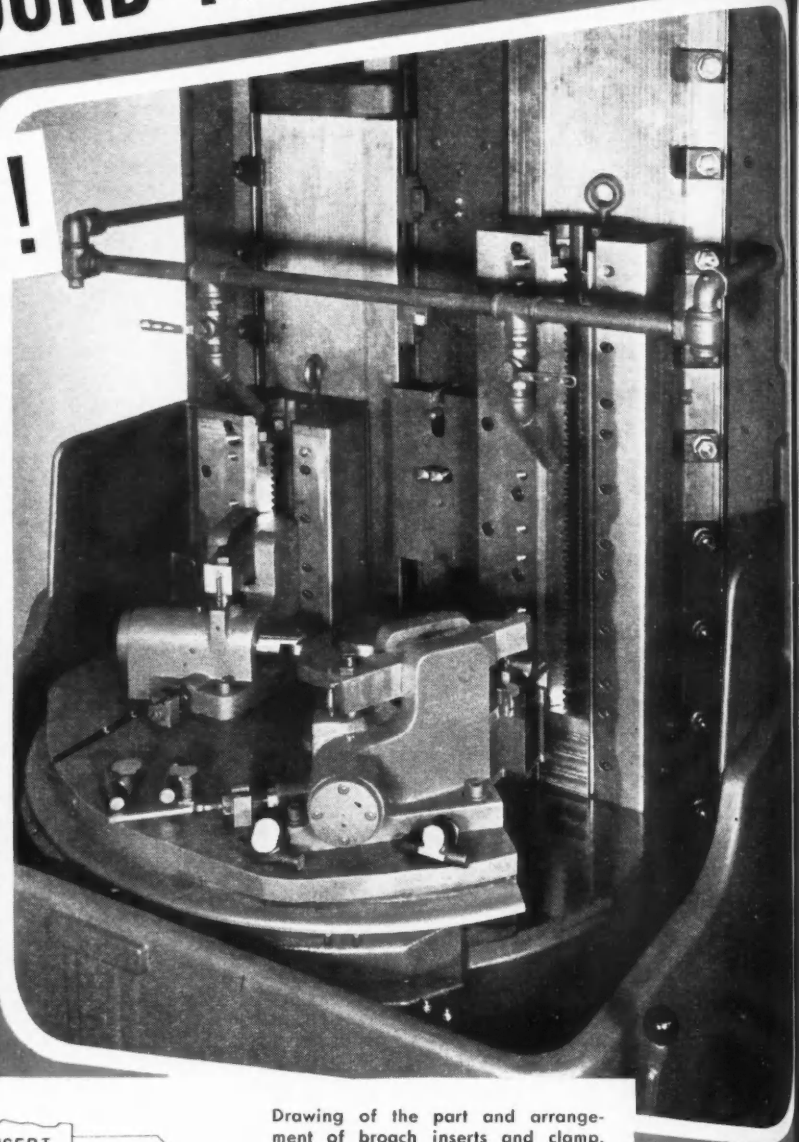
WRAP-AROUND PRINCIPLE

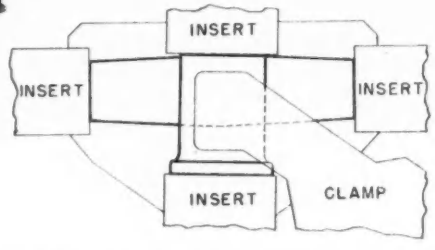
CUTS TIME IN HALF!

SSES AND TWO ENDS BROACHED IN ONE STROKE OF RAM



CINCINNATI No. 10-54 Duplex Vertical Hydro-Broach. Complete specifications may be obtained by writing for catalog M-1387-1.





Drawing of the part and arrangement of broach inserts and clamp.
Part Name—Steering knuckle pin support
Material—Steel forging
Operation—Broach two ends and two bosses
Production—274 per hour (137 each of right- and left-hand parts)
Machine—CINCINNATI No. 10-54 Duplex Vertical Hydro-Broach

Conventional methods of broaching the parts illustrated would probably follow a simple formula: Straddle broach two large bosses in one fixture and then the two ends in another. However, this method would require two setups on a single ram machine or two fixtures and a complete cutting cycle on a duplex machine. Too much equipment and too slow for Cincinnati Application Engineers! These specialists in low cost broaching devised broach holder assemblies and fixtures to broach *both bosses and two ends in one stroke of the ram*, using only one fixture for each of two parts. ¶Equipment consists of a CINCINNATI No. 10-54 Duplex Vertical Hydro-Broach (large illustration above), with fixtures and broach holder assemblies, completely tooled for production. The parts are right- and left-hand steering knuckle pin supports. One set of parts is broached each cycle of the machine. ¶This is another example of the work of Cincinnati Application Engineers in selecting the machine and equipping it for low cost production. Perhaps many parts in your shop could be machined more economically; to higher standards of accuracy and finish; more safely and with less effort. Our engineers will be glad to talk broaching with you.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI 9, OHIO, U. S. A.

MILLING MACHINES • BROACHING MACHINES • CUTTER SHARPENING MACHINES

Why *Car Costs are Higher*

By Leonard Westrate

AUTOMOBILE production has shown considerable improvement in the past few weeks with the easing off of strikes in supplier plants, but even so the added output has not been attained without a great deal of exceptional effort and expense on the part of the manufacturers. The operating losses suffered by practically every company during the first and second quarters of this year are not due entirely to higher factory wages and the low volume, which kept overhead proportionately high. One factor that was generally overlooked until the Automobile Manufacturers Association recently brought it to public attention is the costly improvisation employed by all companies to keep materials flowing into assembly lines.

The industry has shown remarkable ingenuity and resourcefulness in dealing with critical shortages of certain parts and materials. In some cases substitute materials costing considerably more than the item replaced have been used. In others, new sources of supply have been established, involving heavy outlays for tooling and equipment. Also, when vendor sources failed, the car makers have been forced to tool their own shops to produce components not available from the usual outside source.

One of the factors in increased costs not generally known is the tremendous expansion of personnel in purchasing and procurement. Most companies now have double or triple the number of employes engaged in procurement than before the war. A Chrysler spokesman says that his company has converted many salesmen and employes from other departments into expediters and "bird dogs" to work with suppliers and beat the bushes for new sources of supply. Not only are payrolls larger in purchasing departments, but expense also is heavy for travel and long distance telephoning the vendors. As one spokesman put it, "The entire organization from the president of the company on down is working on purchasing and expediting."

Ford Motor Co. has resorted to a great many expensive practices to keep production rolling. During the coal strike, it used bottled gas at one time when the natural gas supply was curtailed and substituted fuel oil for coal in its powerhouse at much greater cost. When certain elements used in paint were unavailable, other ingredients costing considerably more were procured. A substitute for tung oil was found to be particularly expensive. When alcohol used in hydraulic brake fluid became scarce, another type of fluid was found which is fully as satisfactory, but much more costly. With cotton fabric for upholstery short, Ford turned to artificial leather for door panel and upholstery trim. During the copper strike, the company obtained a supply from Chile. Shipping charges, of course, added greatly to the cost. The strike in this country was barely settled when the Chilean mines went on strike.

Buying from new suppliers was not always possible, however, and Ford solved one problem by making steel rods, which it had never produced before, and turning them over to an outside firm for drawing. The wire then was shipped to a fabricator to be made into seat and back springs. Nash drew some alloy wire in its own plants at considerable expense to help out a supplier of seat springs. This company also tooled up for production of its own engine fans when the supply was cut off, and spent three months making dies needed to form bumpers at a new source of supply.

Lack of an adequate supply of bumpers has been an expensive problem for most car companies. They have been forced to spend many thousands of dollars to tool up for production of special brackets for attaching wooden planks to the chassis. One company has estimated that it costs about $20 a car for tooling, materials, and eventual replacements service in the field to equip a car with substitute bumpers. When lumber for bumpers became scarce, Hudson bought a quantity of war surplus armor plate and processed it into bumpers. Since such material is heavily alloyed and in large sections, it was difficult and expensive to handle.

The problem of substitution applies equally to small

(*Turn to page* 60, *please*)

Wage Incentives—

WAGE incentives are being wheeled into the automotive and aviation industries with more speed than ever these days. This is true because management finds itself confronted with the crushing load of higher wage rates and the predicament of a sharply-ascending costs curve. The only out is to boost individual worker efficiency and productivity through a trusted tool sharpened by practical experience. The hard-to-deny fact that many companies have already registered sizeable gains in productivity since V-J Day through the well-planned use of incentives highlights even more graphically just what wage incentives can accomplish.

Moreover, now that tight competitive pricing has come to the automotive and aviation industries, many parts manufacturers realize that "survival of the fittest" hinges upon the sound establishment of new cost-snipping incentives or, at least, upon the overhauling and tightening up of old plans which developed rattles and squeaks during the lush wartime days.

There is no alternative to such cost-cutting. The parts manufacturer who fails to meet his competitors' quotations this year, when a sellers' market prevails, may wake up to find that he priced himself out of a market when vehicle-makers allocate orders next year. There's still another rub. The vehicle-makers may decide to pull some parts contracts formerly sub-contracted into their own shops—unless the parts-maker can demonstrate his ability today to cut costs efficiently. This same situation prevails in the aviation industry, where a strong trend toward integration in manufacturing has been gathering force since the end of the war and has to date broken some tight bottlenecks between plane-makers and vendors.

There's another complicating factor, too. The squeeze placed on parts-makers is paralleled by similar pressures which have made the customers in the vehicle-manufacturing industry more cost-conscious than ever before. In short, under the double stimulus of tight OPA auto price ceilings and a traditionally strong spirit of competition in the automotive industry, executives have fallen back on their ingenuity to lead them toward the best cost-cutting methods available. That's why wage incentives have been placed in the number one slot of "things to do" lists and earmarked "fast action."

It has long been recognized as a fact whenever labor relations experts meet that the average employes will produce at a rate from 30 per cent to 50 per cent below normal capacity unless stimulated to greater efforts. If the initiative, intelligence, energy and ambition of the average worker are to be geared up to the huge task of offsetting inflationary wage rises, skillfully-executed incentive programs must be brought into use. And nothing has been more effective in charging employes with zest and ambition than a company offer of extra dollar bills for a little more effort.

By
William R. Donnell
Vice President in charge of
Management Engineering
Labor Relations Institute

The wide-range possibilities of well-calculated incentive plans are shown by a survey of 541 plants using such systems. Summary results showed that properly-selected and soundly-administered incentives boosted production on an average of 38.99 per cent, reduced unit labor costs on an average of 11.58 per cent and fattened workers' take-home pay by an average of 17.56 per cent! Here are some results achieved in typical automotive and aviation operations:

An aircraft parts plant stepped up production 15 per cent above standard set by the plan, and 73 per cent above past performance.

A die-casting plant increased production 30 per cent above standards, 53 per cent above past performance.

A piston-ring plant boosted production 15 per cent above standard, 27 per cent above past performance.

An aircraft instrument plant increased production eight per cent above standard, 14 per cent above past performance.

A foundry lifted production 17 per cent above standard, same above past performance.

A truck-body plant overshot standard production and past performance by 70 per cent.

An aluminum-casting plant zipped production 13 per cent above both standard and past performance.

A metal-products plant registered a 65 per cent increase over set standard, 103 per cent rise over past performance.

There's no question about the effectiveness of wage incentives as judged by these results — and these reflect only a small section of the larger picture.

Digging more deeply, the problem in the automotive industry is not merely one of establishing new incentives where none existed prior. The problem is how to revamp some of the jerry-built wage incentive plans adopted in wartime and make them effective in peace. When all-out war was the day's agenda, costs were relegated to a back-seat in favor of gigantic production for war at any price. Thus too many companies hastily established incentives that were unsoundly engineered. With business methods nearer to normal today, some of these plans have been scrapped and the rest are in crying need of complete overhauling.

the Way Out

This is not to censure the wage incentive plan, nor make a too-hard judgment of engineering specialists who make its installment from plant to plant their business. The best incentive plan in the world will occasionally get out of line and need some attention. Since 1941, for example, some automotive parts companies have found that perfectly sound incentive plans have been diluted and have lost their former efficiency through the accumulation of a series of wage rises not installed on an incentive basis. The total of these wage rises not installed on an incentive basis. The total of these wage rises since 1941 may average about 34 cents per hour—if not more—and in several instances the incentive rates must be computed separately.

What is needed is a re-evaluation of standards and rates so that the wage rises granted since 1941 become an integral part of the base incentive rate.

In still other cases, individual incentive rates have become unbalanced through changes in product or in methods of production. Such instances illustrate why an incentive plan, once installed, needs constant supervision.

When management finds that incentive plans need tightening up, or when it wants to establish a new plan where none existed prior, a series of preparatory moves is highly essential before the engineering is brought in. More than one company has seen an otherwise sound incentive plan crash on the rocks of worker and union resistance because not enough attention was given to laying

(*Turn to page* 68, *please*)

Do's and Don'ts for Wage Incentives

1. **DO put in a plan to fit your individual needs. There are no "home-made" plans available that can be put in without bringing in the expert engineer.**
2. **DO make your plan simple enough for employes to figure out their own earnings.**
3. **DON'T "spring" a plan on workers before a careful "selling" program in advance. In securing advance worker acceptance, DON'T be sly or furtive under any condition. Lay your cards on the table and call a spade a spade.**
4. **DON'T forget to fit your foreman into the picture. Watch out for runaway take-home pay where workers make more or as much as their foreman. Make special adjustments for this.**
5. **DON'T attempt to keep workers informed without using the foreman as your "follow-through" spark plug. Let him supplement all printed matter by talking turkey with workers in his department.**
6. **DO leave your incentive plan open to grievance adjustments. Pave the way for all individual complaints over incentive rates and standards to be handled through regular grievance machinery.**
7. **DO count the union "in" on your plan before bringing in the engineers. In doing this encourage suggestions from union officials but don't give them too much rope with which to throttle an otherwise sound incentive.**
8. **DON'T make the plan too rigid. Allow for flexibility and avoid any "mutual agreement" clause with the union which would tie your company's hands on any additional changes without union permission.**
9. **DO hitch the wage incentive to job evaluation. Without job evaluation first, no wage incentive will function. To disregard this is to invite disaster.**
10. **DON'T expect overnight miracles to result after wage incentive is established. Incentives are geared for long-range results and require up to three months to start clicking.**
11. **DO make provision in your plan for worker compensation during waiting periods for tools or materials and during stand-by time for machinery or equipment repair.**
12. **DON'T abolish merit increases merely because you have established an incentive plan. Incentives and merit increases together are two good management tools. Neither can substitute for sound management.**
13. **DO keep your plan under constant supervision. Watch particularly employe earnings.**
14. **DON'T put in your own arbitrary adjustment without calling in the expert. This will throw the whole system out of gear—with serious results.**

Rise and Decline of the

By P. M. Heldt

TODAY steam automobiles are relics of a bygone age. They may be found in museums and in the collections of antique-car fanciers, but one never meets them on the public highways. Yet for a period of three years, from 1900 to 1902, when the automobile industry was in its infancy, steam cars were its principal product. In 1899, when a light, cheap steam runabout of attractive appearance was placed on the market, it became popular almost over night. The silence and flexibility of the vehicle—qualities inherent in the steam propulsion system—were apparent even to the onlooker, and they helped to sell it to the "motor-minded" public in spite of its many serious defects, until a light gasoline car was produced which shared some of the advantages of the steamer and was free from most of its defects. A few manufacturers who succeeded in eliminating the more serious defects of the early models continued to produce steam cars for a good many years, but production finally ceased completely in 1923.

The Stanley brothers in the original Stanley Steamer

The history of the steam-propelled road vehicle really divides into two distinct periods. The first of these, which began with the construction of a steam military tractor by Cugnot in France in 1769, extended almost over a century, but did not produce a single really practical vehicle. It may be argued that there is a great difference between a tractor designed to haul field pieces in military campaigns and a private passenger car, and this is quite true, but there can be little doubt that if the early experiments with military tractors and steam-propelled public conveyances had been crowned with success, production of passenger cars for private use would have followed in short order. Developments during the period referred to are connected chiefly with the names of Murdock, Trevithick, Gordon, Gurney, and Hancock in England, and Nathan Read and Oliver Evans in this country. There was a regular steam-carriage boom in England during the 1830s, and one writer lists no fewer than seven different "steam-carriage" and "steam-coach" companies, registered there during that period. From the names of these companies it appears that most of them planned to engage in interurban passenger transportation.

It was about this time that steam power was introduced on railways, and it seems that thereafter men familiar with this motive power were engrossed in problems connected with railway rolling stock, and neglected road transportation. It is sometimes asserted that the railways killed this early motor-road-transport movement, but in the writer's opinion this is not a correct view of the situation. Railroad transportation was much more highly developed at the beginning of the current century, yet it did not prevent the growth of the automobile industry. The real reason for the failure of the early attempts was the lack of a suitable resilient tire that would both cushion road shocks and provide adequate road adhesion for the traction wheels.

A new chapter in motor road transportation opened in 1895 with the advent of the gasoline automobile, and the movement was given a strong impetus by the contests organized here during that and the following years. Electric (storage-battery) vehicles were introduced at practically the same time. Hence there

American Steam Car Industry

Part One

Steam as a motive power for road vehicles was the first to be employed with anything approaching widespread success and there is at least some speculation today regarding the desirability of reconsidering its possibilities for certain special applications. In America, steam cars were the first mass production units turned out by the industry and they gave a marked impetus to its growth. P. M. Heldt, a pioneer automotive engineer who, until his recent retirement, was Engineering Editor of* Automotive *and* Aviation Industries, *has written a most interesting series of articles, of which this is the first, on the rise and decline of the steam car in America.—Ed.

were at least three motive powers available, and the question of their relative merits was widely discussed. Men familiar with steam power—of whom there were a great many in the country—usually pinned their faith to steam. They argued that it had been, and was then, the great motive agent of the world's transportation on land and sea, and they felt confident that it would fill a most important role also in road transportation.

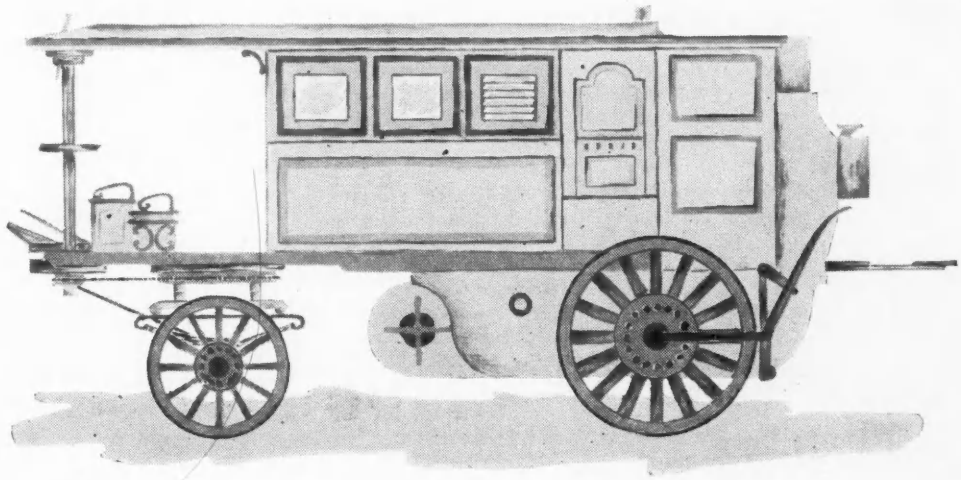
Let us briefly consider the problems that had to be solved to adapt steam power to road locomotion in a practical way. Various types of boiler, including fire-tube and water-tube, were in common use, and flash boilers had been discussed and tried out to some extent. The nearest approach to the conditions met with on an automobile probably were those found on light steam launches. These generally were equipped with vertical fire-tube boilers, coal-fired. Solid fuel, however, was not suitable for use on passenger cars, owing to the dirt, the attention required, and the difficulty of controlling the fire so as to conform to the varying demands for steam. Liquid fuel must be used, and the development of a practical liquid-fuel burner that could be easily started and readily controlled was one of the first problems calling for solution.

Then there was the problem of draft. Draft in furnaces usually is induced by high chimneys. Only a chimney of very moderate height could be used on a car, and even that was objectionable on account of its effect on the appearance.

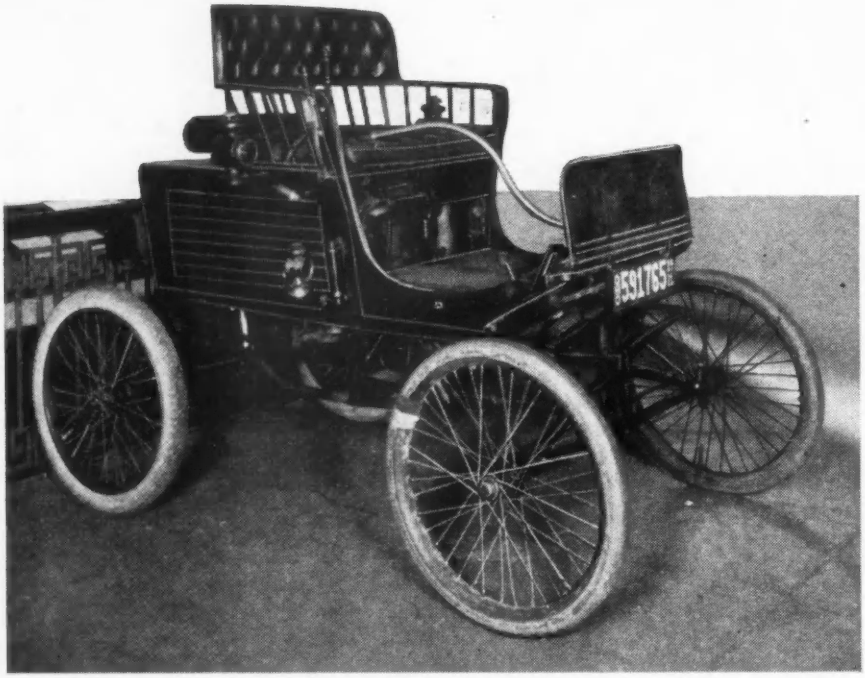
Safety was another consideration. In order that the engine might be able to produce adequate power without being excessively heavy, high steam pressure must be used, and the idea of sitting on top of a boiler carrying, say, 200 lb steam pressure, subjected to the additional strains due to road shocks, with the ever present danger of collision and upset, did not appeal to the timid, hence it was necessary that convincing proof of the safety of the boiler be furnished to prospective buyers.

Control of water and fuel feed had to be more or less automatic, in view of the exceedingly variable demand for power in driving up hill and down dale. All high-pressure steam plants so far had required licensed engineers to operate them, and when the subject of steam vehicles was broached, the first question usually asked was—"Does it require an engineer to run it?" This could not be admitted, as it would have constituted a fatal handicap for steam in competition with the other motive powers.

Other problems related to the location on the car of the various parts of the powerplant, the transmission



Hancock Steam Coach "Autopsy" (1833). This and other steam propelled vehicles were operated on the roads of Great Britain in regular service for a period of years. Nearly 4,000 passengers, for example, were carried by this coach and a sister vehicle between London and Moorgate and Paddington during the summer of 1834. The London and Birmingham Steam Coach Co. was organized at about that time.



Mobile steam car at early Chicago show

of power from the engine to the driving wheels, and the disposal of the exhaust products—both smoke and steam—in such a manner that they would not annoy the occupants, nor be too conspicuous to people in the street.

The earlier experimental work on steamers had been done for the most part on large vehicles of the omnibus type, and requirements with respect to the powerplants were not so exacting. In the new era in road transport ushered in by the bicycle, attention became centered on the small vehicle for family use. Several pioneers in the steam vehicle field whose work immediately preceded the manufacturing period realized the requirements with respect to motive power in small vehicles, and the results achieved by them had a certain influence on later developments. It is noteworthy that most of the development work in connection with light steamers was carried out in New England, and particularly in and around Boston.

Conspicuous among these pioneers was Sylvester H. Roper of Roxbury, Mass., who had a four-wheeled machine on the road in 1863, and a two-wheeled one (a steam bicycle) in 1870. All of his later work was done with this type of machine. With one of these steam-powered two-wheelers, equipped with a boiler of 10 in. diameter and 20 in. height, and with a two-cylinder 2 by 4-in. engine, Roper made a mile in 2 minutes 14 seconds. Powdered charcoal was used as fuel. Roper continued his experiments until his death in 1899, which resulted from injuries received in an accident sustained when demonstrating his latest machine on the Charles River track at Boston.

Another early worker was James H. Bullard of Springfield, Mass. After some experiments with a coal-fired boiler, Bullard developed a multiple-jet liquid-fuel burner in which the fuel was atomized by air under pressure. His most outstanding work was done in connection with automatic devices, and a machine he brought out in 1886 is believed to have been the first in which all of the essential functions were automatically controlled. The air pressure for fuel feed and atomization, the fire itself, the water supply to the boiler, and the boiler pressure were all designed to be automatically maintained between fixed limits, leaving the driver free to give his undivided attention to the road and to other traffic that might be encountered. This machine was operated in the streets of Springfield in 1886. From 1900 on a steam car of Mr. Bullard's design, known as the Victor, was manufactured by the Victor Automobile Company, which was organized by A. H. Overman, a former bicycle manufacturer.

Credit for much of the pioneer work in the light steam-car field is generally accorded to George E. Whitney of East Boston, Mass. Whitney built his first machine in 1896 and drove it over the roads to New London, Conn., whence he shipped it to New York by boat. He built a second machine in 1897. This was exhibited at the bicycle show held in Mechanics Hall, Boston, that winter, where it was driven around the building and served to give many people their first automobile ride. The early Whitney vehicles were equipped with a fire tube boiler weighing 83 lb and with a 4-6 hp engine of the enclosed type, secured to the forward side of the boiler.

Whitney was a prolific inventor, and in July, 1900, had five patents on steam-wagon construction issued to him, with no less than 159 claims. All of these patents were assigned to the Whitney Motor Wagon Company of Boston. The improvements covered by these patents related chiefly to the drive, running gear and control. It is noteworthy that Whitney used the tubular trussed running gear (which later on became very popular for steam vehicles), a cross spring in front, radius rods from the swiveled front axle to the frame, a boiler-engine assembly under the single seat, and chain drive from the engine to the rear axle, with a band brake on the exposed differential gear at the center of the axle.

The general opinion at the time seemed to be that as far as the powerplant was concerned, there was little chance of securing any really broad patents, because steam power was already more than a century old, and the various devices used in its application had been developed along different lines to a high degree. So far as is known, the Whitney Motor Wagon Company never did any manufacturing, and it finally passed under the control of the Locomobile Company

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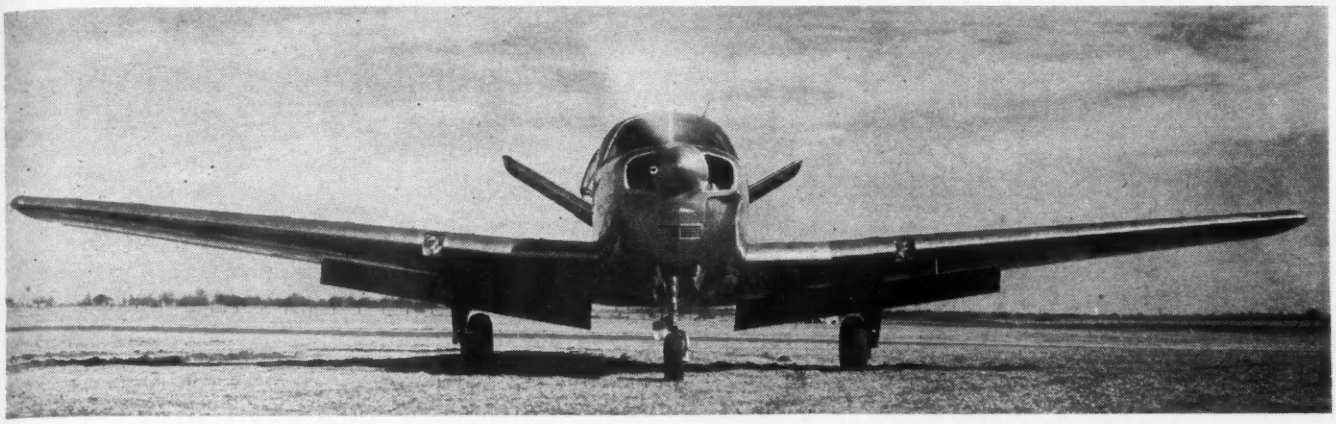
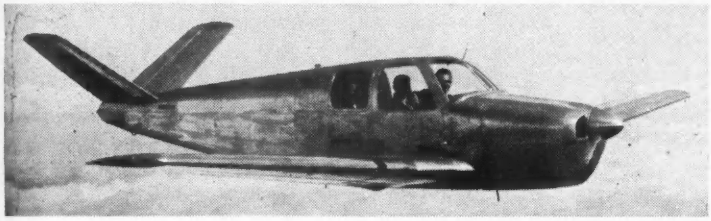


The Bonanza shown upon landing, with full flaps down and the right rear window opened

The Beechcraft Bonanza Model 35



The V-tail is a prominent feature of the Bonanza

THE Beechcraft Bonanza is a four-place, all-metal, low wing monoplane with fully retractable tricycle landing gear, solid cabin top, V-tail, and fully equipped for day, night and instrument flying. This airplane has been designed to carry a passenger load of 680 lb plus a baggage load of 100 lb with fuel tanks loaded for a range of 750 miles at a cruising speed of 165 mph or a range of 700 miles at a cruising speed of 175 mph. The weight of flight instruments, heater, radio equipment, or night flying equipment need not be deducted from the carrying capacity because all of that equipment is standard equipment and is included in the empty weight.

The direct operating cost of this airplane, when used approximately 100 hr per month, is said to be less than 1.5 cents per passenger mile counting three passengers only and not including the pilot. The following specifications of the Bonanza have been announced by the Beechcraft company:

Performance

Top speed at sea level,* 184 mph.
Recommended cruising speed* (at 115 hp), 175 mph at 10,000 ft.
Rate of climb at sea level,* 950 fpm.
Service ceiling,* 18,000 ft.
Take-off run, sea level, 10 mph wind, 425 ft.
Landing run, sea level, 10 mph wind, 315 ft.
Stalling speed, sea level, with 30 deg flaps,* 46 mph.
Stalling speed, sea level, without flaps,* 59 mph.
Maximum range at 165 mph at 10,000 ft, 750 miles.
Fuel economy, depending on speed and altitude, varies from 14.5 miles per gal to 18.8 miles per gal.

Weights

Gross weight, 2,550 lb.
Empty weight, 1,490 lb.
(Empty weight includes complete set of flight instruments; radio receiver, transmitter, marker beacon receiver, homing loop, and automatic antenna reel; cabin heating and ventilating system, with windshield deicers; soundproofing; continuously variable controllable pitch propeller; navigation, cabin, instrument, and landing lights.)
Useful load, 1060 lb.
Payload with full tanks, 780 lb.
* Guaranteed within 3 per cent.

Wing Area and Loadings

Wing area, 177.6 sq ft.
Wing loading, at gross weight, 14.35 psf.
Power loading, at gross weight, 15.45 lb per hp.

Dimensions

Wing span, 32 ft 10 in.
Length, 25 ft 2 in.
Height, 6 ft 6.5 in.

Cabin Dimensions

Cabin length, 6 ft 11 in.
Cabin width, 3 ft 6 in.
Cabin height, 4 ft 2 in.
Passenger door, size, 36 in. x 37 in.
Baggage door, size, 24 in. x 22 in.
Baggage compartments, size, 16.5 cu ft.

Power Plant, Propeller, and Equipment

Engine—Continental, 6 cylinder, E-165, rated at 2050 rpm at sea level at 165 hp equipped with pressure carburetor.
Propeller—Beech, electrically controlled, continuously variable pitch, type R-100, diam 7 ft 4 in., with Beech R900-101 pitch control motor, and Beech spinner.

Engine Equipment

Starter—Delco-Remy No. 2514.
Generator—25 amp, Delco-Remy No. 1656-25.
Voltage regulator—Delco-Remy No. 6221-25.
Battery relay—Cutler Hammer No. 6041 H 105.
Fuel pump—Carter 112-22.
Carburetor air filter—Beech.
Mufflers and cabin heaters—Beech, stainless steel.
Exhaust manifolds—Beech, stainless steel.
Vacuum pump, vacuum regulator and oil separator—Type B-11.

Fuel and Oil Capacity

Fuel capacity in two wing tanks, 40 gal.
Oil capacity, 11 qt.

Landing Gear

Tricycle type with full swivelling nose wheel equipped with shimmy dampener. Main tires 6.50 in. x 8 in. size; nose wheel tire 5 in. x 5 in. size. Wheels—Goodyear with single disc hydraulic brakes.

Electrical and Radio Equipment

Battery—24 amp hr capacity.
Electric motors for operating flaps and landing gear.
Radio receiver with beacon and broadcast and marker beacon reception, cabin loudspeaker, rotatable aural null loop with orientation dial on instrument panel.
Radio transmitter.
Automatic retracting trailing antenna, marker beacon antenna.
Microphone and headset.

Standard Flight Instruments

Airspeed indicator—Eclipse-Pioneer.
Sensitive altimeter—Kollsman.
Turn and bank indicator—Eclipse-Pioneer.

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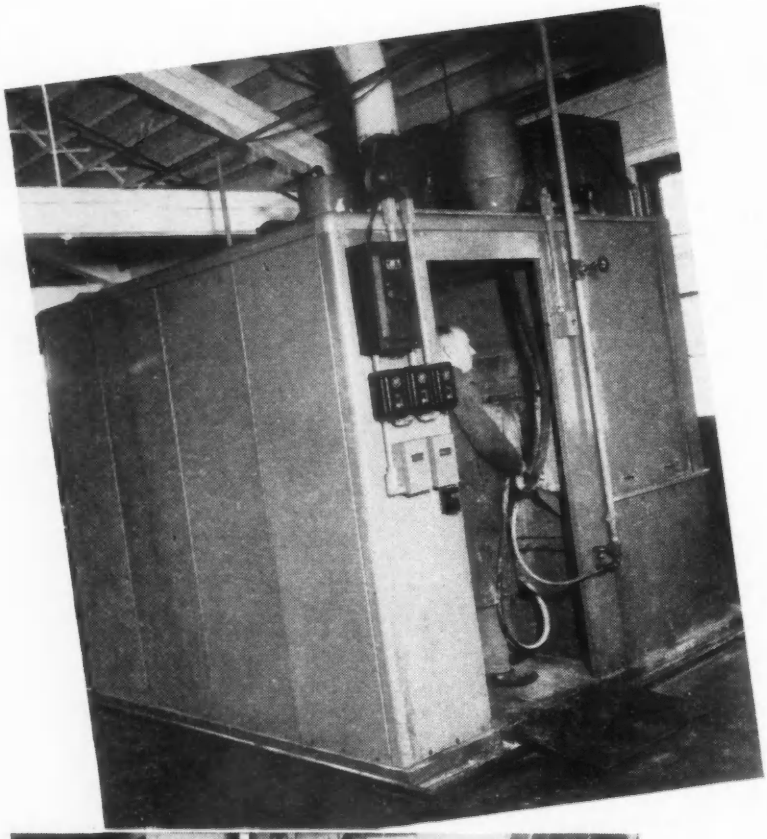
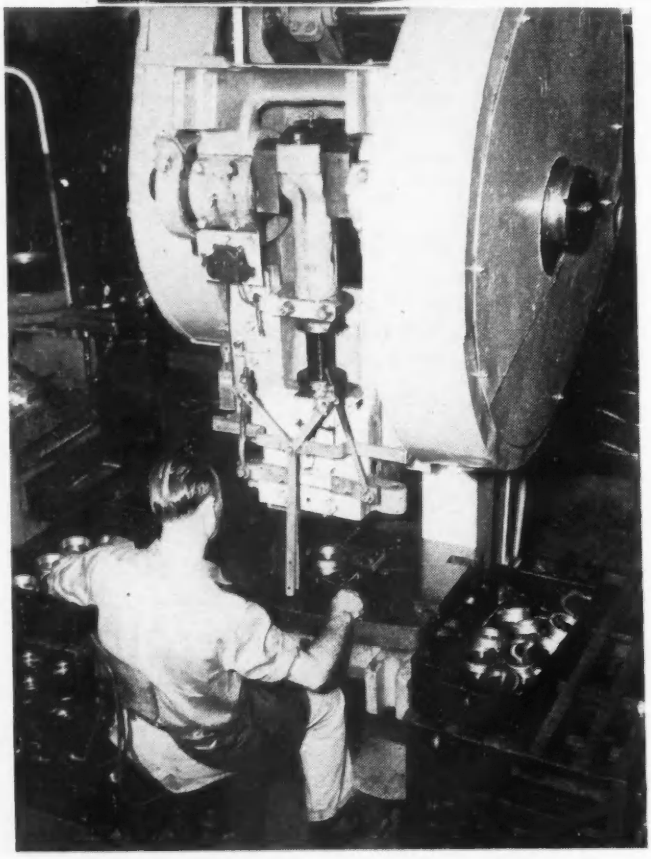
Timken's Proving





PROVING ground for advanced manufacturing practices leading to improvement in product quality and cost reduction is the unique function of the Division of Research and Development of The Timken Roller Bearing Co. This project holds much of interest to the management of plants of the industry since it marks the establishment of a separate plant—divorced from the machine shops and assembly lines of the production department—for trouble-shooting, for the improvement of machines and fixtures and tooling, for the development of advanced methods, for the investigation and design of inspection instruments and gaging devices, and for the testing of new machine tools before they are installed in the production departments.

Although the Division was formed late in 1943 real progress was delayed until after V-J Day. Now it is fully prepared to deal with any problems presented by other divisions of the company. It is autonomous in its operation, activities being under the control of a board or committee headed by Henry Timken, Jr.

Some of the problems presented to the Division may be in the nature of trouble-shooting; some involve improvement in quality as part of a long range program of giving the users a superior product. In all cases, the project is thoroughly investigated as to methods, productivity,

This is the 120th in the series of monthly production features

(Above) This is the Vapor Blast Honing cabinet installed in the Research and Development department for carrying out studies leading to the utilization of the new process.

(Left) This Bliss press stamps the bearing identification following green grinding on the Blanchard.

Ground *for Advanced Manufacturing Practices*

dimensional accuracy, surface finish, and cost, thus providing a basis upon which the study can be accepted. The important fact is that all of this work is done outside of the production department and does not get into the plant proper until the report has been accepted. In such cases the Division is prepared to assign skilled personnel with a given job to get it started properly.

The Division also boasts a well equipped toolroom capable of making tools and fixtures; special machinery or attachments for machines; and for making gages, instruments, or special experimental equipment for all requirements.

Because Timken bearings rely largely upon grinding and super-

By Joseph Geschelin

(Right) View in one corner of the division of Research and Development, showing part of the modern toolroom facilities.

finishing operations the Division devotes much of its attention to the improvement of grinding operations and grinding machines; to the selection of the proper grades of wheels, and development of the most practical forms of wheel dressing devices. In the process, particular pains are taken to evolve techniques for the elimination of chatter and burning in grinding operations. Control of roundness and concentricity also are given attention with emphasis on fine dimensional control.

In addition to the selection of grinding wheels, there is a constant search for better cutting tools, better form and layout of tools. Fixtures and chucking devices also are studied, one of the by-products being the development

(Left) An example of the many processes and products produced by the division of Research and Development is the horizontal sound and stand gaging machine for testing assembled cones. Its features are described in the text.

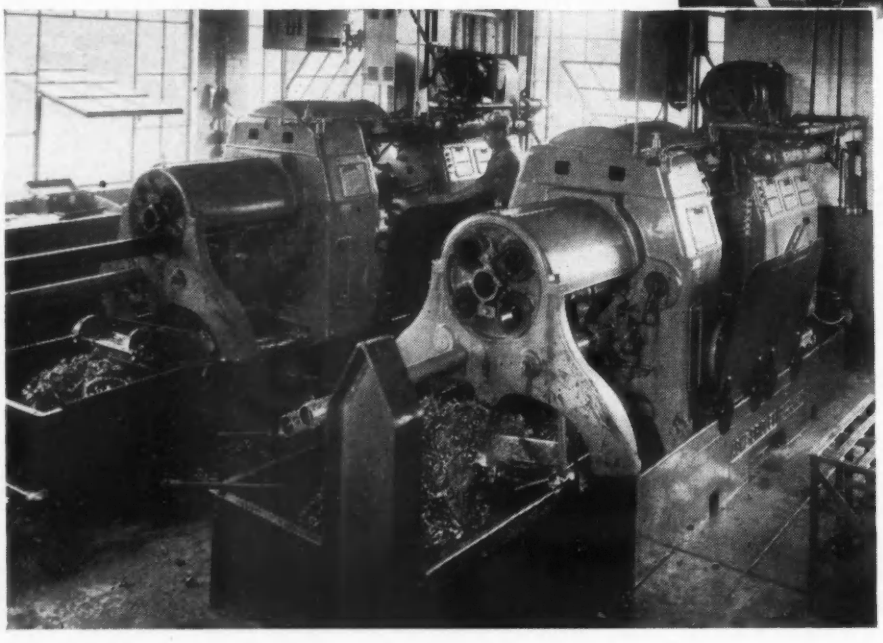
of an interesting form of diaphragm chuck which contributes to concentricity and freedom from distortion of parts such as races and cages.

Most plants have little or no formal means for the testing and selection of cutting fluids. Here, the cutting fluids are tested on a production machine with the regular production set-up of tools and work, but under controlled laboratory conditions which assure proper utilization. Only after the project is completed and accepted does the specific cutting fluid come into the production department.

The same is true of new or radically advanced machine tools suitable for Timken's manufacturing process. Before a new type of machine is adopted, the first installation is made in the Division's machine shop where the equipment is studied, tooled, and placed in regular operation on a small lot scale. Such adjustments or revisions as are usually necessary in the adoption of any new machine are made by service representatives of the maker of the unit. Following this trial period, if the machine is acceptable from the standpoint of the Division, the final report is turned over to the manufacturing department for further action. It is obvious that this procedure places in the hands of the machine shop only such equipment as is known to be ready for installation and operation in a mass production department.

A great deal of work is done on gages and instruments in the interest of simplifying the control of critical dimensions as well as making the operation foolproof. Among such items was the recent development of an electronic sound gaging device for use by blind operators. In this case they adapted a standard instrument by the addition of a sound box which gives warning of oversize or undersize by a unique tone. Whenever new quality control methods are developed, they are tested over a period of time and then the production operators are given a period of training in the experimental department before the technique is adopted for production.

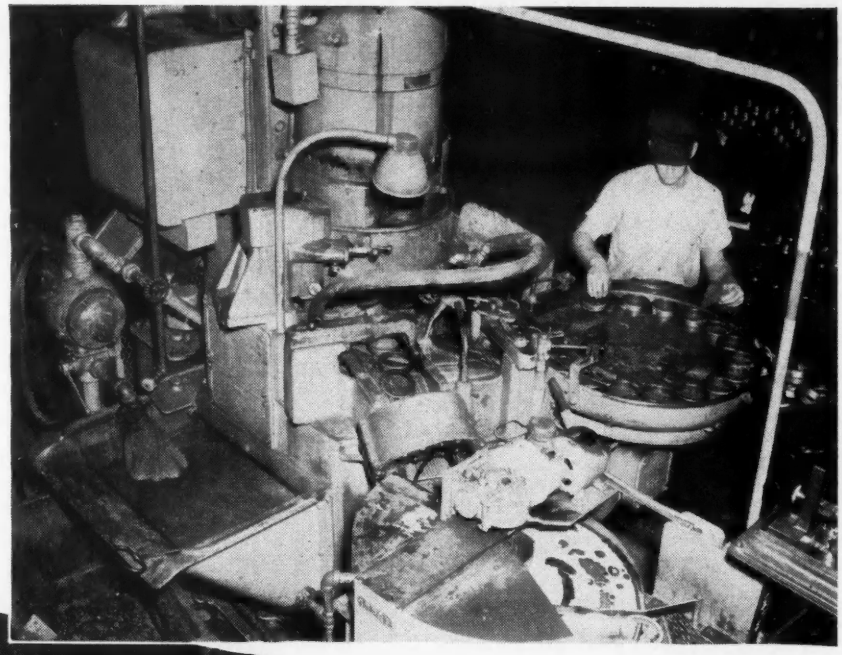
Consider as another example, a new technique such as Vapor-Blast liquid honing. This process became generally known during the war and has been adopted by many manufacturers. Under Timken's set-up a Vapor-Blast cabinet has been installed in the experimental shop and will be subjected to considerable testing primarily to determine where the process can be most useful in the manufacture of bearings. As applications are found, sample production runs are made on selected parts to determine the economy and



(Above) Close-up of the No. 81 Heald internal centerless grinder used for grinding the ID of bearing cups after heat treatment.

(Left) Start of operations at Zoarville—a battery of two four-spindle National Acme-Gridley automatics cut alloy steel tubing to form and length, producing the bearing cup blanks.

(Right) Second operation on the bearing cup is surface grinding of front and back surfaces in this Blanchard grinder. The same machine is used for finish-grinding after heat treatment.



(Below) The OD of heat treated cups is finish-ground in this Cincinnati Centerless Grinder.

utility of the method. Later, as specific applications are approved, suitable reports are made to the production department leading to their adoption.

It may be of interest to comment briefly on a few specific projects. Project No. 69, for example, had as its objective an improvement in the life of Carboloy tooling for boring mills by increasing the number of pieces per grind. The work was conducted on a 42-in. Bullard V.T.L., the parts consisting of a large double cup, single cup, and three types of single cones.

The parts are made from ring forgings of Krupp steel which are rough-turned to leave 3/16 in. stock all around, then heat treated and finish-machined. Rough turning speeds ranged from 120 to 170 sfpm, the variations being due to unequal hardness. Finish-turning was done at 180 sfpm since the material was more uniform after heat treatment. Feeds of 0.033 in. per revolution were used both for rough and finish operations.

The report is supplemented with sketches showing the arrangement of tooling for each operation on each part number; and tabular data as to machining time for each operation on each part.

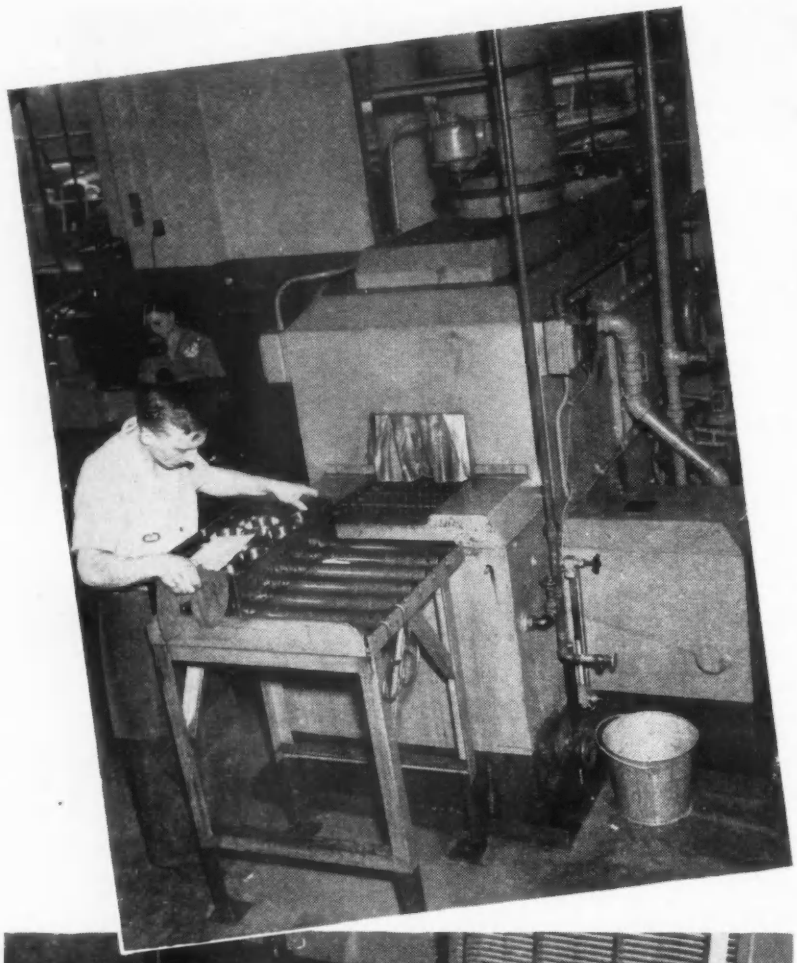
The conclusion is given as follows: "With few exceptions where improperly annealed forgings were encountered, all runs were made without regrinding the tools. We feel that it is reasonable to expect this type of tool, under these conditions, to give satisfactory performance throughout one eight-hour shift without redressing."

Project No. 81-1 deals with the development of a horizontal testing machine for sound testing and stand gaging assembled cones. As shown in the accompanying photo, this machine represents a major improvement over the equipment used heretofore, with the following new features:

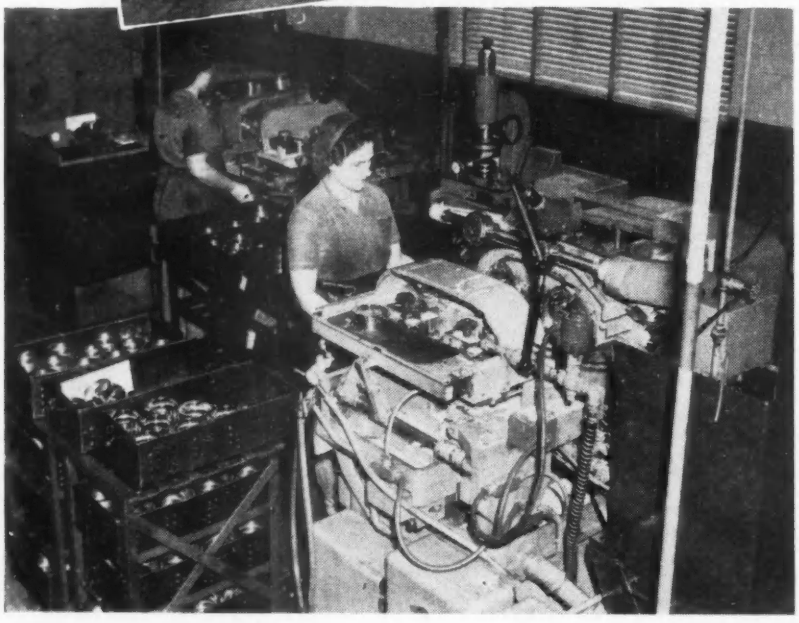
1. Air operated pressure slide.
2. Multiple plate type thrust bearing in spindle.
3. Operation from a sitting position.
4. Addition of a number of safety devices.
5. Controls operated by the operator's feet.

The body of the report contains a discussion of each of the new features to show reasons for their adoption. An example of this is the following: "Machine controls are operated by the feet, leaving hands free to feed machine. Should operator fail to remove his hand from feeding position while operating foot control, the guard will rest on the hand and prevent operating switches from making contact."

"Machine was put through complete mechanical and electrical tests and found OK and has now been sent to the assembly line for tests under actual production conditions."



(Left) This compact Detrex washing machine cleans the work prior to inspection and packing. The heated solution is a soluble oil mixture which also provides rust-proofness.



(Below) The new technique is the turning of the race to grinding tolerance and finish —holding to 0.0005 in. plus or minus on the OD—in the Heald Bore-Matic at the left. Races then go to the Heald Bore-Matic in the foreground for precision boring of the ID.

A study of some of the other projects completed recently shows emphasis upon making machine cycles foolproof and tamper-proof. This is important at Timken for the reason that all production workers are on an incentive pay basis and tend to speed up operations so as to increase earnings. Since any changes in machine operation may contribute to work spoilage or poor quality it is important to provide positive foolproof cycles.

One of the aspects of this operation is quite dramatic in its execution. Some time ago the experimental department conducted a study of the grinding of bearing cups with the objective of reducing the number of grinding operations. It was reasoned that if the amount of grinding were reduced, the resulting work would be subjected to less heat strains and might produce better quality from the standpoint of dimensional tolerances, metallurgical structure, and service life.

Ultimately, they developed a procedure in which the turning and boring on Heald Bore-Matics, in the green, was done to grinding tolerances and finish. After heat treatment, only single finish-grinding operations were required for the OD and the inner taper bore.

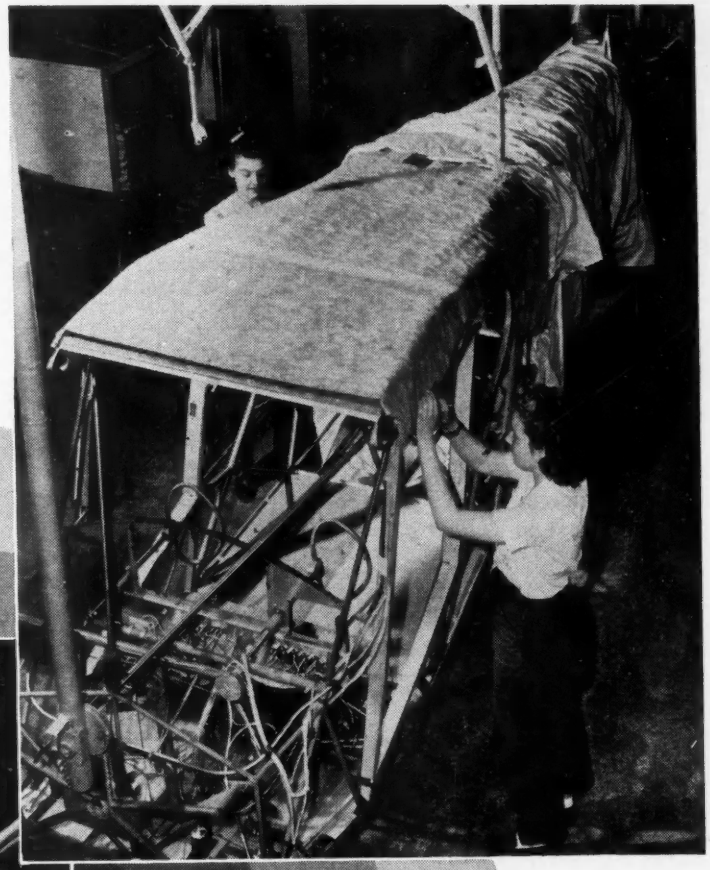
At this point the management decided to test out a pilot production set-up complete in every respect from start to finish, but on a small scale so as to demonstrate the virtue of the new technique. Later a pilot plant was established in a small building in Zoarville, Ohio, some 18 miles south of Canton, which was leased for the purpose. The building was then equipped as a miniature mass production operation complete with all of the machinery and process equipment. It has been operated for almost a year continually accumulating data as to quality, productivity, and prime cost. Eventually these data will be digested and reviewed to determine whether or not the process would justify a complete change in the manufacturing set-up in the bearing plant.

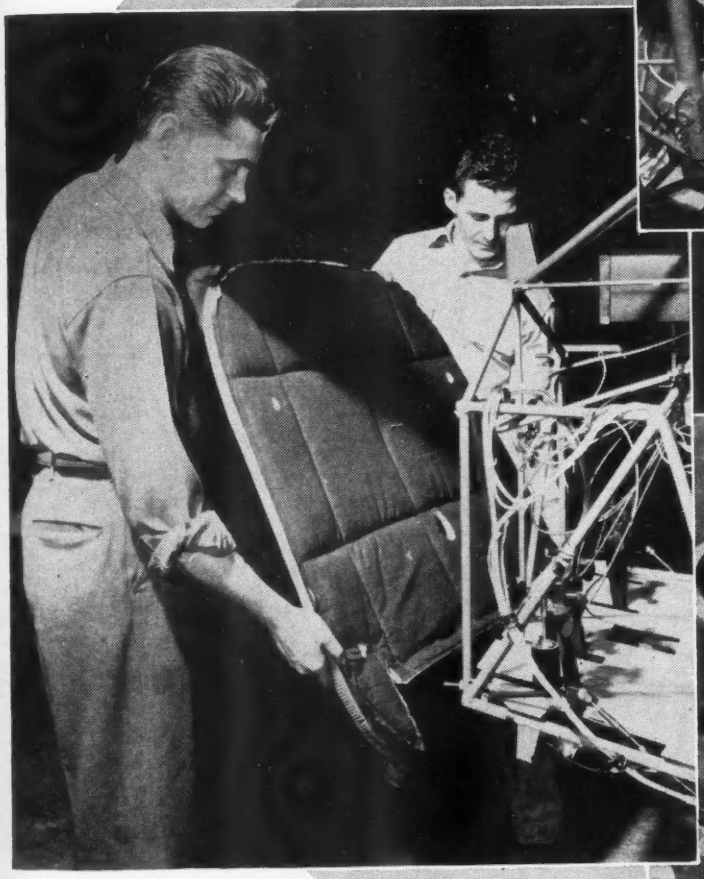
As a matter of interest we give below a brief description of the pilot operation, supplemented by photographs of the equipment.

The process begins with a battery of two, large four-spindle National Acme Gridley automatics, each of which produces completely roughed bearing races from steel tubing. The blanks are ground to length on the top and bottom surfaces, successively, on a Blanchard surface grinder. Following this, the bear-

(*Turn to page* 67, *please*)

Cabin Soundproofing





(Center) Installing firewall with one-inch thick Fiberglas material between plane's engine and cabin

(Top) Fiberglas blankets are being attached to the cabin superstructure of a Stinson Voyager 150. Skin fabric shown in the background is then pulled over the blankets

(Right) Interior of plane cabin showing sound-absorbing blankets being applied to sidewalls and around windows. The blankets are finished with a trim fabric

Evaluation of the Surface

By T. H. Wickenden,
G. R. Brophy,
A. J. Miller
Development and Research Division,
The International Nickel Co., Inc.

THE various methods for evaluating the surface durability of gears, which include metallurgical tests, tests of gears and wear tests of specimens designed to simulate gear conditions, have not always accurately indicated service experience. The need for an improved technique for the purpose has been recognized and an attempt has been made through the cooperation of the General Motors' research staff and the International Nickel's technical staff to develop a suitable machine and method of test. The aim has been to conduct tests of gears under controlled conditions of load, temperature, speed and lubrication; and, to eliminate, as far as possible, the unavoidable, complicating variables encountered in the manufacture of gears. The primary concern in these tests is with the deterioration of the teeth surfaces which fail by pitting rather than with the beam fatigue strength of the teeth. Ultimately, it is hoped, a comparison of gear materials and their preparation may be made.

Test Specimen and Testing Machine

The test specimen, Fig. 1, is a 28-tooth helical gear with a pitch diameter of 3.5302 in.; normal pressure angle of 20 deg, helix angle of 7½ deg and a tooth face width of 1 in. In operation a pair of gears are opposed and rotate in different planes which include an angle of 15 deg, thereby developing an elongated eliptical contact area which is more or less restricted to the central portion of the tooth and eliminates the complication of end effects. The area of contact may be visualized by considering the contact between two crossed cylindrical surfaces. By thus restricting the contact area, the test stresses may be increased to the desired maximum without approaching the beam endurance limit of the teeth. With the particular test gear used, i.e. a 1 in. tooth face width and a 7½ deg helix angle, the upper limit of stress is about 250,000 psi.

The machine operates on the "four-square," or closed circuit, principle in which two pairs of gears are opposed—one pair a permanent part of the machine and the second pair the test specimens. The usual design was modified to accommodate opposed gears rotating in different planes, by arranging the shafts at an angle of 15 deg and the insertion of four constant velocity universal joints in the shaft lines to bring the two gear boxes to the same level. Two universals were used on each shaft line to reduce the operating angles of each to safe values. The details of construction of one of the universal joints and one of the gear boxes with gears, bearings and seals in position are shown in Fig. 2. The other universals and gear box are similarly constructed.

Another feature of the modified design is the mounting of the test gear box on trunnions so that a torque may be applied to the system by means of weights placed on a pan hung from a torque arm, effectively 12 in. long, which in turn is fastened to the box. The reaction to this torque develops the stress in the gear teeth.

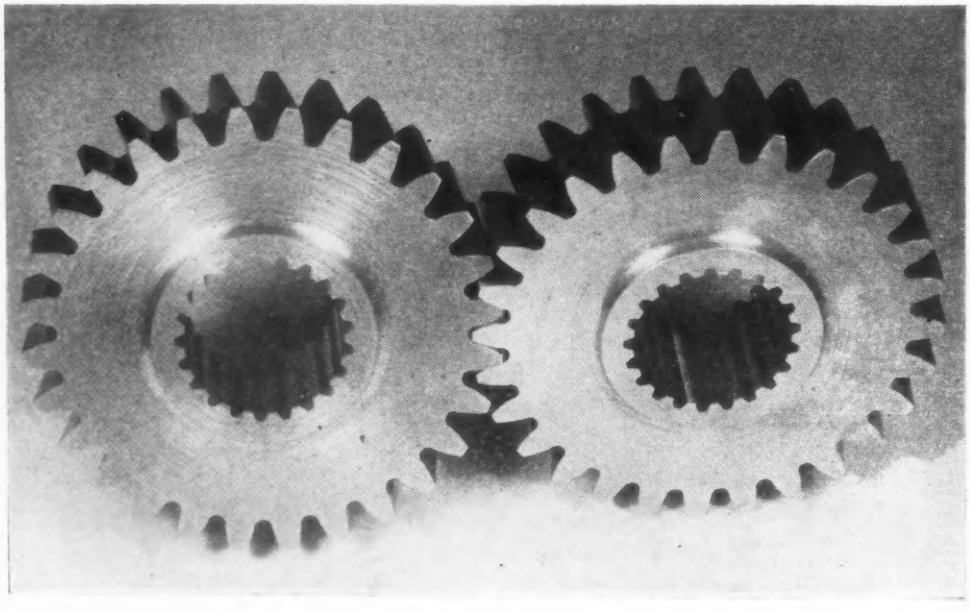


Fig. 1—Test gears are installed in the testing machine to rotate in different planes which include an angle of 15 deg.

Durability of Gears

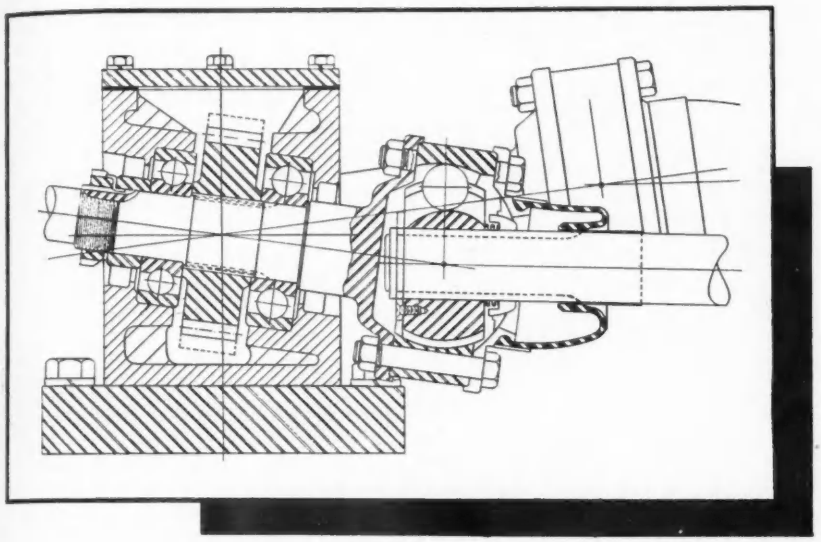


Fig. 2—A cross section view of the gear box and universal joint

Photographic views of the equipment are shown in Figs. 3 and 4. Each gear box is equipped with a transparent cover and is kept filled to capacity with oil,* pumped during operation in a continuous flow through the box under a constant pressure of 30 psi. The oil is supplied through flexible lines and valves 7 and 8, Fig. 4. The oil outlet is located at the end of the box opposite the inlet and returns the oil to the storage tank through lines located beneath the table of the machine. An important aid in filling and emptying each box and for the prevention of air entrapment is an air valve which is closed during operation, located at the top rear or outlet end of each box.

The oil supply is maintained at any desired temperature to ± 5 F by means of a thermostatically controlled immersion heater and a water cooled radiator. The circulating pump, radiator, and oil filter are mounted above the tank (see Fig 3).

The gear train is driven by three vee belts at a speed of 900 rpm by a 3 hp; 1200 rpm induction motor mounted beneath the table at an angle of 7½ deg from the horizontal. A magnetic brake, located just behind the motor, Fig. 4, is actuated by an adjustable overload relay mounted on the frame behind the motor. In the event of an unexpected failure of any of the rotating parts, the increased power operates the relay and brake to stop the machine. Hand operated emergency stop buttons are placed at three points on the machine. In addition there is an adjustable limit switch placed immediately beneath the torque arm which is actuated in cases of excessive wear, tooth fracture or serious vibration. In passing, it may be stated that there has been no necessity for any of the emergency devices to operate.

In starting a test, the oil temperature control system is placed in operation and when the desired temperature is reached the load is placed on the pan and supported; the motor is started, the load released, and the reading taken on a Veeder counter directly connected to the driven pulley. Oscillatory vibration of the system is prevented, except at the very lightest loads, by a dash pot placed under the counter balance arm at the rear of the test gear box.

Gear Life Indication

With the idea that as the teeth surfaces deteriorated under test conditions, the power losses would increase, a recording power meter was connected to the motor power line. The power record, together with visual examination, demonstrated that the gear efficiency continued to improve even after pitting was well advanced. On the other hand the deterioration of any of the rotating parts of the system—joints and bearings—was recorded. In a few early tests this gave false indications of end points. Because of its unreliability this method of indication was discarded.

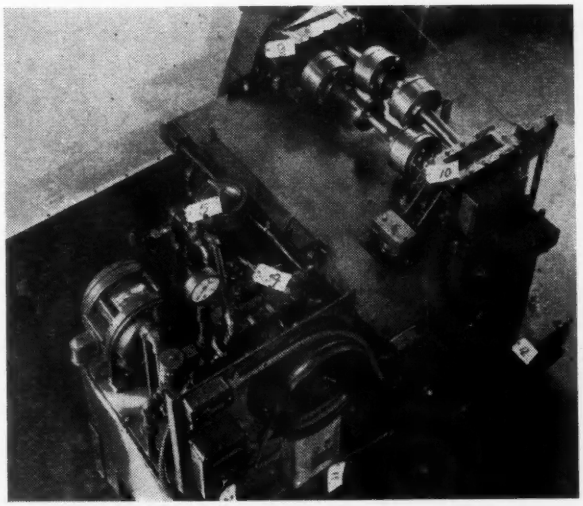


Fig. 3—Top view of gear testing machine showing oil pump system and temperature controls

* In the tests to be described SAE 30 E.P. oil was used, but this of course is one of the controlled variables.

It was noticed, however, that when the gears had pitted seriously, the volume and tone of the sound emitted from the machine had changed audibly. This suggested that a noise meter might yield a dependable indication of destructive pitting.

Accordingly, a simple and inexpensive devise was assembled which measures the noise levels in terms of millivolts. It consists of a "Kontak," high impedence microphone, mounted on the weight lever, feeding into an amplifier and vacuum tube voltmeter. A continuous record of the voltage output and, therefore, noise level is obtained with a recording potentiometer.

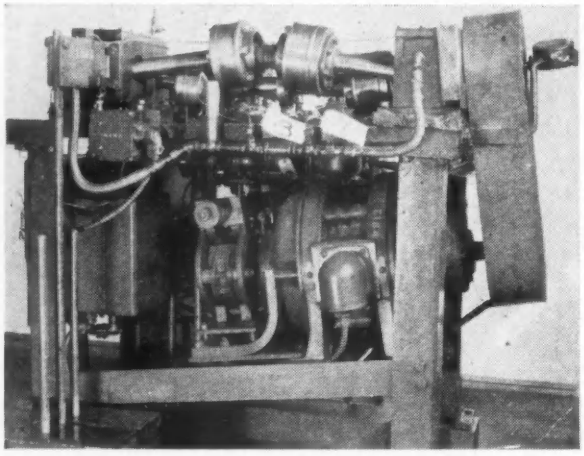


Fig. 4—Side view of gear tester showing drive shafts, motor, brake, weight, arm, etc.

A few typical examples of noise level records, replotted on a logarithmic time scale to sharpen the end points, are shown in Fig. 5. No real significance should be attached to the initial millivolt level of any test, for that may be adjusted at will, and has been, in order to space the records. Failure or destructive pitting of the teeth surfaces is marked by a continued rise of the noise level.

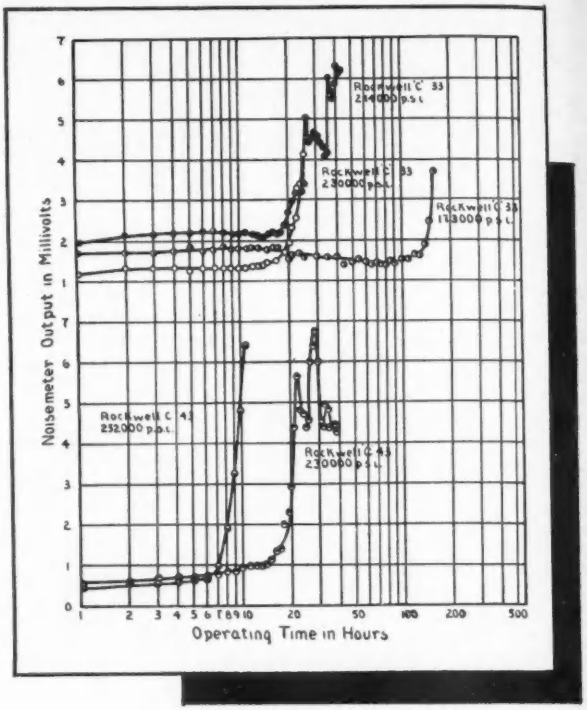


Fig. 5—Some typical gear test noise records

Illustrative Tests

Among numerous tests already conducted were some on gears made from SAE 4645 steel. Forged blanks were annealed, turned, and splines and teeth roughly cut. The rough gears were then oil quenched and tempered to three levels of hardness: Namely, R_c 30, R_c 36, and R_c 43; after which they were finished on a Fellows gear shaper. Because of the procedure of finish machining after heat treatment, the hardness of the test gears was limited to R_c 45.

All tests were conducted at 215 F in the manner of fatigue tests in order to develop the stress life relation and to establish, if possible, the stress below which the gear life is indefinitely long. The data are contained in Table I and the derived stress-life curves at each level of hardness are shown in Fig. 6. These have the shape characteristics of fatigue curves. When the indicated stresses for lives of 5×10^7 cycles are plotted against the hardnesses of each group, the curve of Fig. 7 results, which again is characteristic of fatigue in that higher stresses for indefinite lives

Table I—Data from Gear Fatigue Tests

Steel						Heat Treatments							
	Compositions					Quench	Draw						
Type	C	Ni	Cr	Mo	Mn	Temp. °F	Temp. °F	Rc Hardness	Loading Torque Lb-Ft	Calculated Stress	Life in Cycles of Stress	Probable Stress 5×10^7 Cycles	Remarks
SAE 4645	.48	1.61	.....	.23	.68	1550	800	43.5	650	243,000	2,400,000		
								43.5	650	243,000	2,950,000		
								43.5	500	228,000	4,570,000		
								43.5	500	228,000	4,800,000		
								43.5	430	217,000	7,600,000		
								43.5	410	214,000	25,200,000		
								43.5	400	212,000	12,900,000		
								43.5	400	212,000	32,090,000	212,000	No failure
							1025	36	650	243,000	1,080,000		
								36	500	228,000	2,400,000		
								36	410	214,000	5,100,000		
								36	360	205,000	12,000,000		
								36	340	202,000	37,930,000	203,000	No failure
							1100	30	340	202,000	5,700,000		
								30	340	202,000	6,000,000		
								30	300	194,000	17,100,000	135,000	No failure

are found as the hardnesses increase. It is fully expected that this trend will continue to higher hardnesses than those studied. Indeed, the performance of the permanent gears of the machine furnish excellent support for this expectation. They are made of carburized SAE 4600 steel, hardened and tempered to R_c 63, and have withstood, without distress, the summation of all tests conducted to date—a total of more than five hundred million cycles of calculated stresses ranging between 150,000 and 250,000 psi.

Stress Calculation

The calculation for the compression stress in the teeth is made through the application of the following equation (1):

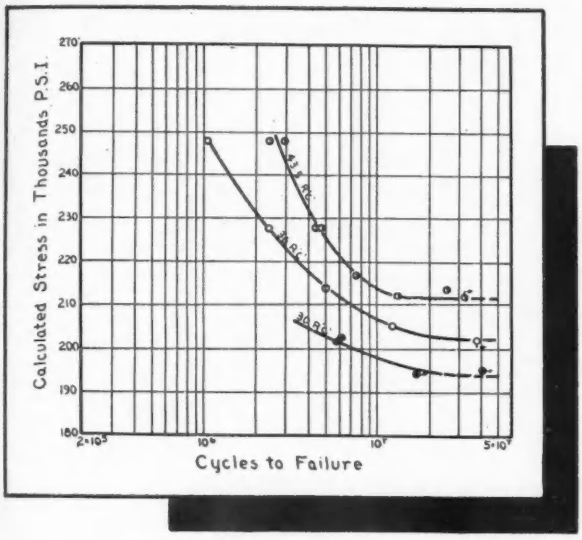


Fig. 6—Stress-life curves of SAE 4645 steel gears

$$\text{Compressive stress} = \frac{23.600}{\alpha \times \beta} \sqrt[3]{\frac{4\,T\,(\tan^2 \alpha_n \cos^2 \Delta)^2}{\cos \Delta \sin^2 \alpha_n}}$$

in which

α_n = Normal pressure angle = 20 deg.

Δ = Helix angle 7.5 deg.

$\left.\begin{matrix}\alpha \\ \beta\end{matrix}\right)$ = Functions of the involute tooth form and the angle between the contact line = comparative length and breadth of the contact area.

$\alpha \times \beta$ = Function of the contact area.

T = Torque in in. lbs on the gear = ½ loading torque

Simplified the above becomes: $15{,}600 \sqrt[3]{T}$

The formula is rigorously mathematical. It does not provide for velocity and assumes only elastic deformation and perfection of surfaces and contours which, of course, is not attained practically. For this reason, it was desired to obtain a measure of the actual compression stresses involved in these tests by calculation from contact areas. The method of determining the contact areas was to plate one of each pair of test gears with 0.0008 in. of copper; place the pair in the machine under static load and to vibrate the system through a small amplitude for one hour. The contact area was thus well defined as a bright polished area on the copper plate. Because of imperfections on the surfaces, the contact areas were never of uniform width and frequently were discontinuous as the one shown for an exaggerated condition in Fig. 8 which was obtained on a particularly poor surface at a light load. More perfect surfaces of course, produce more continuous contact areas of relatively narrower and uniform widths.

(1) Developed by J. C. Straub, General Motors Research Laboratory.

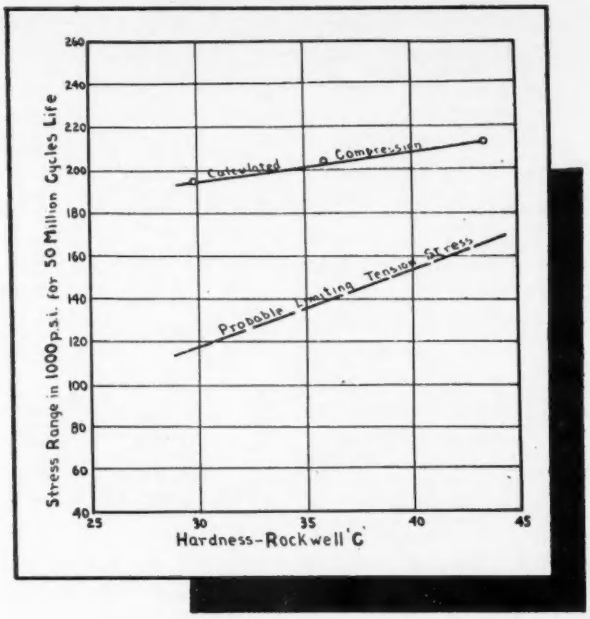


Fig. 7—The calculated compression and probable limiting tension stress ranges for 5 x 10 cycles life—loading 0 to maximum

The teeth were then cut from the gears, were photographed at magnification and the gross and net contact areas determined by projecting the images on a cross sectioned screen and counting occupied squares. The gross area was taken as the total area enveloping the numerous small contact areas and the discontinuities while the net area was the summation of the actual contact areas only. The average compression stress over the projected zone was then calculated by:

$$Sc = \frac{\text{Load}}{\text{Area}}$$

$$\text{where load on tooth} = \frac{\text{½ loading torque (in. lbs)}}{PR}$$

and PR = pitch radius = 1.75 in.

The results are plotted in Fig. 9. The average compression stress over the gross projected zones plot with considerable scatter as might be expected with imperfect surfaces. The mean of this scatter band, however, probably represents a close approximation of the true average stresses over the gross projected zones. When the areas actually bearing the loads, that is the net areas, are considered, the true average

stresses approach those calculated by the formula more closely as the loads increase and imperfections are eliminated through plastic deformation. Within the range of loading torque used, the deviation from the formula stress is indicated to be about 15 per cent at 200 lb-ft, but decreases with increasing torque to about 3 per cent at 625 lb-ft. The suggested small but constant difference at higher loads may be the difference between the calculated maximum and the determined average stresses. Agreement between calculated and determined stresses over the full stress range should improve with improvement of surfaces and hardness.

The Nature of Failure

The stresses calculated are compressive. According to Almen (2) fatigue failures do not result from repeated compressive stresses but only from repeated tension stresses. The tension stresses which cause failure in these gear tests must be of a lower magnitude than the calculated compressive stresses. An idea of the values of the maximum safe repeated tension stresses for steels of these hardnesses is obtained from the lower curve of Fig. 7. This is the statistical

Fig. 8—Section of contact area on gear tooth; light load (X9 mag.)

relation under ideal conditions between hardness and the limiting safe stress for a stress range zero to maximum. These stresses are about 80 per cent of the tensile strengths and are about 60 per cent higher than the limiting safe stresses for complete reversal (3). They probably represent the maximum safe values of the effective tension stresses involved in these gear tests.

The stresses which initiate failure, however, must not be simple tension for they originate from two sources: (1) the tension component of the operating compressive stress, and (2) the tangential tensions in the teeth surfaces developed by the action of the teeth during operation. The second is believed to be of greater importance because of the conditions peculiar to this test. It will be recalled that the test gears rotate in different planes which include an angle of 15 deg and because of this, each tooth slides endwise over its mate during the entire period of contact. Observations show that the first sign of tooth distress during test is a scoring action which develops a series of graceful "arrowhead" markings with their apexes on the pitch line pointing in the direction of

(2) SAE Transactions, Vol. 51, #7, p. 248.
(3) Moore and Kommers, Fatigue of Metals, p. 192.

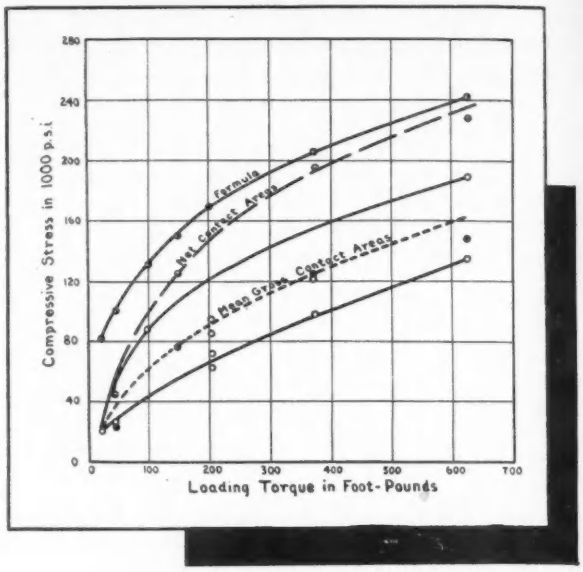


Fig. 9—Stress on gears, calculated and determined from contact areas

the sliding see Fig. 10. This frictional force must develop a high degree of tangential tension stress in the tooth surface and it is evidently more severe in the driving tooth, for it always pits first and more extensively. This is probably associated with the fact that the surface metal in the driving gear is pulled away from the pitch line both during engagement and disengagement, whereas, in the driven gear, the tendency is to move metal toward the pitch line.

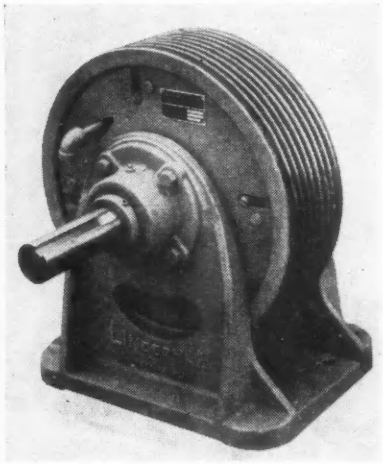
Microscopical examination of incipiently failed gears indicated that first, fatigue cracks form normal to the tooth surface as well as to the direction of the surface forces. Subsequently, a particle of metal is sheared out from this crack in the direction of the force to form a pit which in the driving gear is away from the pitch line and in the driven gear toward it. This is so characteristic that inspection usually reveals which of a pair of gears was driving and which was driven. Once started the spread of pitting is rapid and destructive. At this stage the noise emitted increases continuously.

The use of this machine as a laboratory tool has been very satisfactory and the work is being continued. As an ultimate aim we hope to be able to compare materials of gear construction and their treatments but it has been learned already that many factors must be closely controlled. The immediate problem is to specify a finish which can always be duplicated since this has been found to be of utmost importance.

Fig. 10—Badly scored tooth illustrating direction of forces (X3.785 mag.)

New Production and Plant Equipment

LINDERMAN DEVICES, INC., Newburgh N. Y., is now producing a line of brakes designed to apply accurately controllable continuous tension in industrial machinery. Available either as self-contained units, or for building into equipment under design, the brakes



Linderman industrial tension brake

are a development of the standard Linderman industrial safety brakes.

Features of the brake which make it suitable for applying continuous retarding force are the absence of self-energizing action; ability to apply even heavy loads under ordinary factory air-line pressures; radial shoe actuation, eliminating sensitive adjustments and high pressure areas; use of 90 per cent of the drum area for braking.

As shown in the accompanying illustration of the self-contained type of Linderman brake, drums are heavily finned to provide maximum heat-dissipation under continuous application. If desired, fan cooling can also be provided, the brake assembly being enclosed within an annular sheet metal housing in such an event. The brakes may be operated with equal efficiency in either direction.

Application of shoe pressure to the drum is through multi-stage steel diaphragms—one for each shoe. These diaphragms make it possible to use a minimum of expansion, since the shoe travel obtained is the sum of the expansions of each stage of the diaphragm.

Brake shoes incorporate a wedge mechanism to adjust for lining wear. The only parts requiring occasional lubrication are the adjustment screws and the shaft bearings. In the brake proper there are no operating parts which require lubrication.

Due to the closed design of the brake actuating mechanism, the only air consumed is that required to expand the diaphragms to apply the initial pressure against the drum.

WEIGHT reductions said to average 40 per cent are featured in a new line of standardized material handling equipment just brought out by the Monroe Auto Equipment Co., Monroe, Mich. The line consists of six products offered in various standardized sizes to include a total of fourteen units of platforms, nestling rings, boxes, skids and pallets, all available for immediate shipment. The weight reductions in the new line are accomplished by redesigning the equipment, using high tensile steel instead of hot rolled low carbon steel.

The Monroe material handling equipment line includes the following units: Basic platform skids for storage of boxes and flat material; nesting rings for use on platform skids to convert to boxes; platform boxes designed for forgings, castings and small parts; wood and steel platform skids; wood and steel pallets; and all-steel pallets.

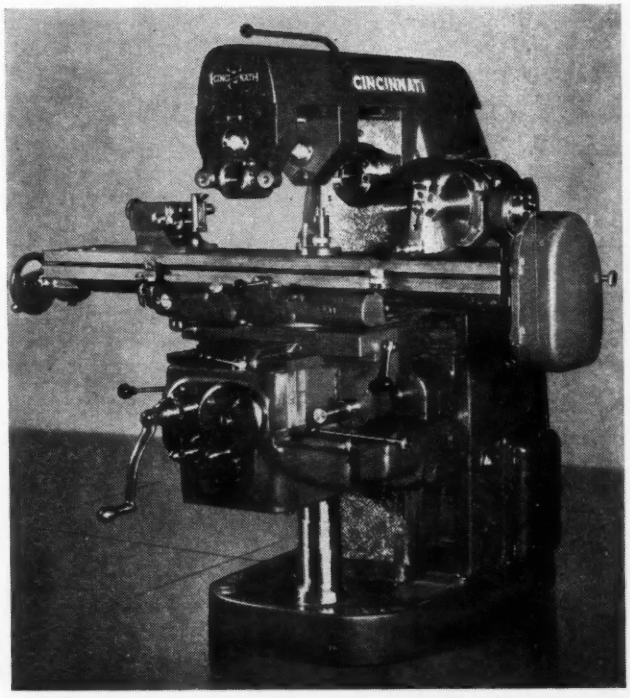
A NEW, medium-sized knee-and-column type milling machine has been brought out by the Cincinnati Milling Machine Co., Cincinnati 9, Ohio. Designated their No. 2 MI, the machine is powered by a 5 hp motor, and built in plain, universal, and vertical styles.

These machines have exceptionally wide speed and feed ratios—60 to 1 and 120 to 1, respectively. Sixteen spindle speeds, ranging from 25 to 1500 rpm are changed with a single crank type control. The crank operates a hydraulic selector valve, while the actual work of shifting gears is performed hydraulically. One-half turn of the crank, to the right or left, rotates the dial in the same direction to the next numeral, and meshes the proper gears for that speed. A mechanical spindle reverse, located just below the speed change crank, offers a quick and easy reversal of spindle rotation to suit the "hand" of the cutter. It exerts no effect whatever upon the direction of feeds.

Feed rates are changed in the same manner as the speeds—one-half turn of a single crank type control, throughout the complete range of sixteen feeds, from ¼ in. to 30 in. per minute. The crank and indicating dial are located at the front of the knee. Feed controls are independent of each other, and each feed lever has a forward, neutral, and reverse position. All are equipped with plastic knobs for convenience of the operator. Knee and saddle clamping levers, the starting lever, and the overarm pilot wheel have similar plastic knobs.

Cross and vertical hand cranks are automatically disengaged when their respective power feed lever is engaged. This arrangement constitutes an important safety feature for the operator, as it prevents the hand control from spinning during the feed or rapid traverse movement.

"Live" rapid traverse, at the rate of 150 in. per minute longitudinal and



Cincinnati No. 2 MI universal milling machine.

cross, and 75 in. per minute vertical, may be engaged through a lever control at the side of the knee.

A very effective arbor support brace is supplied with these machines. It consists of a single vertical section which is bolted to the arbor support, while the lower end is a bridle section which clamps to the top of the knee. The brace may be reversed, as desired by the operator, presenting the vertical section to the right or left of the knee.

The main drive clutch, brake, and all spindle drive gearing up to the back gear shaft is contained in a unit bolted to the rear wall of the column. Likewise, feed drive gears are contained in a unit bolted to the underside of the knee.

Vertical style machines have essentially the same controls and construction as horizontal machines, with the exception of the back gear shift lever on the left-hand side of the vertical head. The back gear construction maintains consistently low and more desirable speeds througout the spindle drive. Vertical machines are equipped with power feed and power rapid traverse to the head, and a four-position turret stop. When the power feed or rapid traverse is engaged, the hand-wheel is automatically disengaged, constituting a safety feature for the operator. Feed rates to the head range from ⅛ in. to 15 in. per minute, while the rapid traverse rate is 75 in. per minute. The turret stop serves as a quick and convenient adjustment of the head to two, three or four heights when milling production work having finished surfaces at various heights.

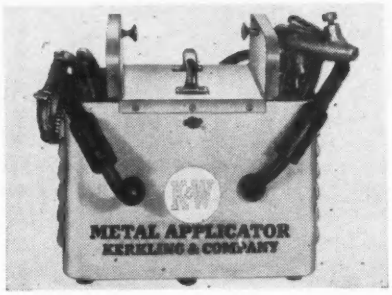
Many attachments are available particularly for horizontal machines. These include circular milling tables, several types of vertical and universe spindle attachments, motorized overarm and manual controls at the rear operating position.

TO SPEED up repair of cracked engine blocks and other metal castings, Kerkling & Co., 1765 San Fernando Rd., Burbank, Calif., is introducing the K & W metal applicator for use in conjunction with the K & W patented mechanical method.

In addition to its primary purpose, the applicator can be effectively used for filling blow holes in castings, brazing and soldering. This makes it a multi-purpose machine that can be used for other types of work as well as block repairs.

The K & W metal applicator is easily portable for moving from job to job. To the transformer are connected an electrode cable which leads to the electrode holder, and a ground cable, connected to a heavy duty bronze clamp which is fastened to the work.

A vibrating electrode holder may be had in place of the standard holder, permitting faster application of the metal. Nickel, bronze and aluminum, as well as K & W special alloy electrodes are available, permitting repair on all types of metal castings.



K & W metal applicator

K & W metal applicators are offered in two models, Super and Master. The Super model is a heavy-duty applicator, capable of long, uninterrupted operation. The Master model is suitable for ordinary block repair shops wherein the use of it is intermittent, and the continuous use at one time does not exceed an hour.

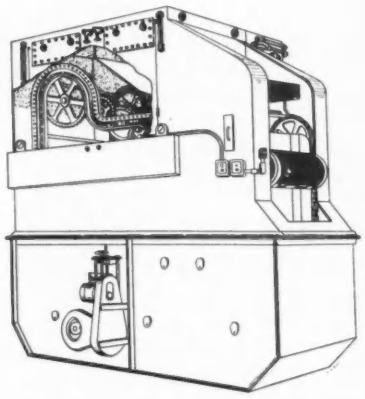
A SPECIAL-PURPOSE machine has just been designed and built by Snyder Tool and Engineering Company, 3400 E. Lafayette, Detroit 7, Mich., to meet specified requirements of accuracy, finish and rate of production in milling pads on automotive manifolds.

The part is located by means of guides in a work-holding fixture and is clamped manually by means of cam-action clamps. All spindles in the five-spindle milling head are mounted in anti-friction bearings. Helical gears are used througout in the construction of this head. The head and fixtures are cast iron construction. The cutters travel past the work for the machining operation, which is entirely automatic after the starter button is pressed. And "in" and "out" adjustment is provided for the sub-slide to facilitate cutter loading and adjustment. The welded steel base houses the hydraulic equipment for the travel of the milling head.

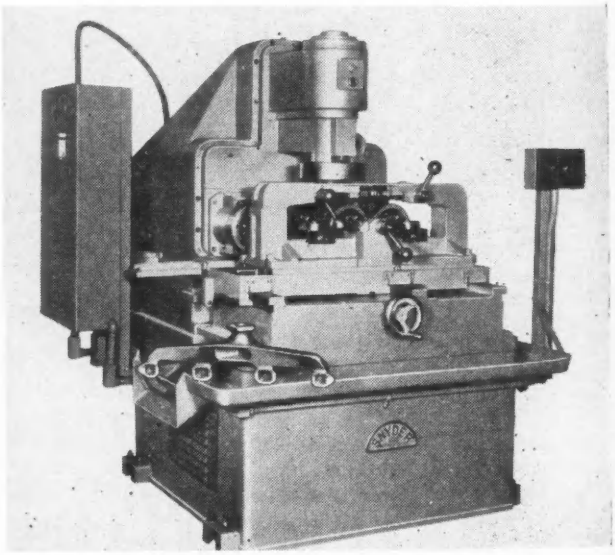
IN ADDITION to its present line of metal degreasing equipment, Detrex Corp., 14331 Woodrow Wilson Blvd., Detroit 32, Mich., has recently introduced a new standard conveyorized one-dip concentrator.

Called the "1 DC-750," this degreaser is small and compact. Designed to degrease small miscellaneous screw machine parts, it is particularly suited to small shops where floor space is at a premium. The machine occupies less than 75 sq. ft. of floor space and measures but 9 ft. 9 in. in height.

The unit may be supplied with rotary or a combination of rotary and flat baskets. Rotary baskets are 10 in. in diameter by 20 in. long. Work to be cleaned is loaded at one end of the degreaser, carried through the cleaning cycle, and is returned through the upper hood to the same end of the machine for unloading. The conveyor system is complete with sprockets, shafts, take-up device, speed reducer and variable speed drive. All of the sprockets below the vapor line are zinc plated as are all crossrods and conveyor chains.



Detrex standard conveyorized one-dip concentrator.



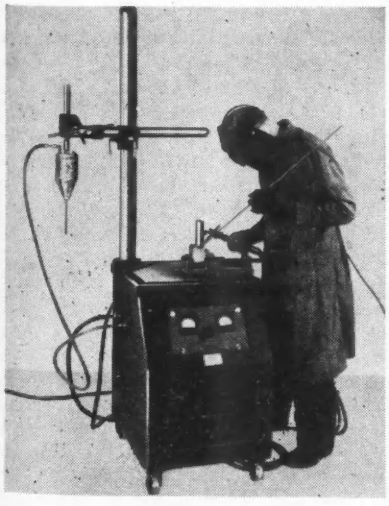
Snyder special-purpose machine for milling pads on automotive manifolds

Phillips Super Vapo-Kleen

PHILLIPS MANUFACTURING CO., 3475 W. Touhy Ave., Chicago 45, Ill., has released information on two new vapor degreasers—the Phillips "Duo" and the Phillips "Super" Vapo-Kleen. These degreasers are said to offer extremely safe operation through the use of Phillsolv, a 100 per cent non-inflammable cleaning solution. They completely clean and dry oily, greasy parts in from one to five minutes, depending on the degree of soil to be removed from the parts.

The essential difference between the two models is that the Phillips "Duo" is designed to handle basket loads or parts up to 12 in. in diameter, whereas the Phillips "Super" is a heavy-duty degreaser large enough to degrease complete motors.

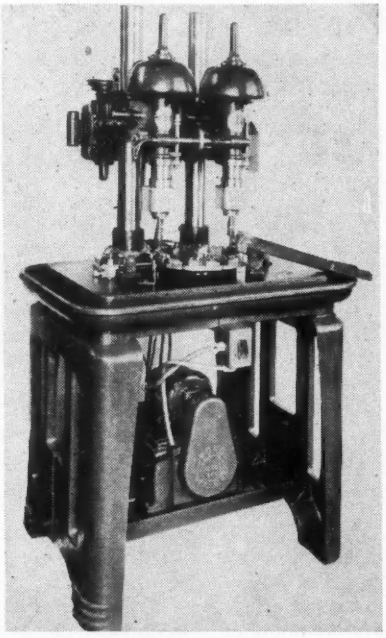
The Phillips "Duo" is offered complete with pre-dip tank, electrically heated vapor tank, controls and thermostat totally enclosed in a metal cabinet with cover. It cleans by dip, soak, or vapor, or any combination of these. The Phillips "Super" likewise is completely contained, offering an added feature of a pressure spray hose for flushing stubborn grease and oil deposits. The "Super" also incorporates the Phillips feature of reclaiming its own dirty solvent automatically by distillation.



Thomas Metal Master

POND ENGINEERING CO., 15 Park St., Springfield, Mass., has designed an automatic control unit to convert hand-operated tapping units to automatics.

Indexing, locating, clamping, tapping and ejecting are all accomplished on a turntable fixture which is actuated by the Pond Operator Model 600. In the machine pictured, two different pieces are handled simultaneously—each piece having one hole to be tapped—and pieces are separated during ejection by an ejection chute which is divided in the middle. An attendant is required to feed the machine if the piece cannot be adapted to hopper or magazine feed.



Pond Operator Model 600

Different pieces of a similar nature can be handled on this same machine by changing the holding blocks on the turntable. Combined operations—drilling, tapping, reaming, riveting, grinding and many others are possible.

The Pond Operator is primarily a control unit with a one-cycle air-clutch-operated cam shaft, powered by a 1/3-hp motor. A minimum of 70 lb air pressure is required. Four air valves are standard equipment, but additional valves and mechanical cams can be added. Cycle speeds are adjustable from two seconds to one minute, depending upon the operation performed, but longer cycles are available on special order. The frequency and duration of impulses per cycle are adjustable on the air valve cams.

MANUFACTURE and sale of the new Thomas 8-in-1 Metal Master, featuring eight different metal-working operations built into one machine, is announced by the Clinton Machine Co., Clinton, Mich.

The new device can be used for metal disintegration, arc-welding, brazing, soldering, drill pulling, air extraction, metal etching and demagnetizing operation in tool and die rooms, tool salvage and maintenance departments, and on production lines.

Completely portable, being mounted on steel casters, the Thomas Metal Master can be rolled to any part of a plant and by connecting to a convenient outlet any of the eight operational units can be put into operation without tear-down or set-up.

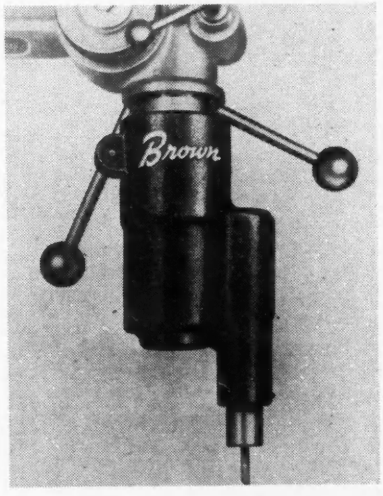
DRIVING or pulling studs by gripping as little as ½ in. of the unthreaded body of the stud is featured by a new combination stud driver and puller. This production stud setting tool, made by Titan Tool Co., Fairview, Pa., is placed over the stud to be set or removed and requires only a slight left or right hand turn to effect a grip on the stud.

When the chuck of the tool is lowered over a stud, the upper end of the stud contacts an adjustable stop screw. This automatically elevates the core and brings the rolls into centralized contact to the cam surfaces in the driving member and stud. When rotation is stopped the tool may be lifted off the stud without reversing the direction of rotation.

The Titan-Kirkland combination stud driver can also be supplied in ratchet type for corners where interference prevents complete rotation of a T-handle tool.

(*Turn to page 82, please*)

Drill Press Converter



Any drill press of sufficient size and strength can be quickly converted to perform filing, cutting, sawing or slotting operations through the use of the unit illustrated. It has only three moving parts. Mounted between two preloaded ball bearings is a solid steel cam which converts the drill press rotary action to a vertical reciprocating action. The main housing is a Durometal casting with bronze sleeve insert for bearing surface. Cam roller is hardened tool steel. The new device is offered in 1-in. and 1¾-in. models by Leo G. Brown Engineering Co., 1157 Riverside Drive, Los Angeles, Calif.

American Steam Car Industry

(*Continued from page 22*)

of America through stock purchase.

To the Stanley brothers of Newton, Mass.—Francis E. and Freeland O.—belongs the credit for having carried the improvement of the light steam carriage to a point where it attracted large capital and became the basis of an industry which for a period of a few years developed at a phenomenal rate. They represented the rather rare combination of mechanical ingenuity and business acumen. The Stanleys, who were manufacturers of photographic dry plates, built their first machine in 1897. They had been interested in mechanical road vehicles since 1887, when they lived in Lewiston, Maine, where a machinist by the name of E. F. Fields built a steam car.

The first Stanley car was equipped with a fire-tube boiler 14 in. in diameter and containing ½-in. tubes 13 in. long. A novel feature of the boiler was that it had a shell of copper instead of steel, this shell being wound with piano wire for strength, the idea having been borrowed from Hiram Maxim, inventor of the wire-wound gun.

While the first Stanley steamer had no reverse motion, which was considered unnecessary for country use in view of its light weight (about 400 lb), this deficiency was remedied in the second machine, the engine of which was equipped with a Stephenson link motion. On the first vehicle there was an automatic boiler feed, intended to relieve the driver of the duty of watching the water glass, but this proved to be unreliable, and a water gauge glass was later fitted at the side of the body. The engine was a two-cylinder, vertical, double-acting type, with variable cut-off.

Stanley Brothers sold their first steam car in August, 1898, and the success of this first machine induced them to make plans for the production of the vehicle on what at the time was regarded as a large scale. By the end of the year they had a lot of 100 in production, and more than this number had been sold. All of the major parts were being made in outside shops, the work at the Newton plant being confined mainly to assembling. However, the various parts were all designed by or under the direction of the Stanleys, who also supervised the manufacturing operations.

In the spring of 1899 John Brisben Walker, at that time publisher of the *Cosmopolitan Magazine*, purchased from the Stanley brothers the rights to their steam car, as well as the plant in Newton, Mass., and secured the services of the brothers for a period of one year. The deal, which was said to have involved a cash payment of $250,000 to the Stanleys, occasioned much discussion at the time, more particularly because it seemed very doubtful whether the conveyance of the rights would give Mr. Walker any protection against competition in the steam-carriage field. However, the Stanley car seemed to be ahead of all competition from the standpoint of all-around practicability, and Walker's plan seems to have been to secure a safe lead by launching immediately an aggressive manufacturing and sales campaign.

Shortly after having acquired the Stanley rights, Mr. Walker disposed of a half interest in them to Amzi Lorenzo Barbour, the asphalt magnate. For a time Messrs Walker and Barbour managed the business jointly, but later two companies were organized to manufacture the little steamer, the Locomobile Company of America, under the control of Mr. Barbour, and the Mobile Company of America, of which Mr. Walker was the head. Both engaged in the manufacture of steam runabouts of substantially identical design, known, respectively, as the Locomobile and the Mobile. In the division of the interests the Stanley plant at Newton, Mass., went to the Locomobile Company, which in 1899 erected on the site a three-story factory building about 40 by 100 ft in dimensions. The demand for the Locomobile grew by leaps and bounds, and in order to cope with it, manufacturing facilities had to be extended rapidly.

General Requirements for Helicopter Engines

By CARL T. DOMAN
Aircooled Motors Corp.

One of the major problems facing the installation engineer in a helicopter application is that of cooling. Under certain conditions of flight, the engine must operate at full throttle with no forward speed of the helicopter and, therefore, no assistance in cooling from the slip stream. This means the engine must be self-cooled, usually by a fan, either of the centrifugal or axial flow type.

In some helicopter installations, proper provision has not been made for the elimination of recirculation of the cooling air within the cowl. As an example, in one helicopter it was found that the temperature of the air entering the fan was 40 deg higher than the outside air temperature, because a portion of the heated air leaving the cylinder fins passed around into the fan entrance. The installation of proper baffles eliminated this condition.

Engineers apparently have been so burdened with major problems other than those concerning the engine, that the selection of the cooling fan has been given but little thought. A fan properly adapted to an engine requires considerable research work in selecting the shape of the blades, contravanes, air baffles, etc. On the other hand, the engine designer has been responsible in many cases for overheating. In one experimental engine it was found that with a given cylinder head design, approximately 20 in. of water was required to force air through the cooling fins in order to prevent cylinder head temperatures above 500 F at the spark plug gasket. At 3200 rpm the fan absorbed 60 hp with the engine developing a net of 180 hp. A redesign of the cylinder head, increasing the cooling surface of the cylinder from 1200 sq in. to 1450 sq in., resulted in an engine which would cool very satisfactorily with four in. of water. Only ten hp was required to drive the fan. Maximum head temperatures never exceeded 450 F, although the air entering the cooling system was 110 F.

It is also important that the entrance to the fan be properly designed for minimum restriction; otherwise the fan which the designer might have selected on a good engineering basis would not operate to capacity. To prevent disintegration of the fan under high-speed operation, it was found necessary to isolate it from the mounting member through the use of rubber bushings. In the majority of the cases where the fan has failed if mounted solidly on the crankshaft, torsional surveys peculiarly have not indicated any serious amplitudes. Nevertheless, the substitution of rubber has eliminated the trouble.

In certain installations an exhaust system has been used which has had excessive restriction. Perhaps small exhaust pipes had been used in order to miss some part of the structure which had not been planned when the helicopter was originally designed. Back pressure of one to two in. Hg. is satisfactory. However, five to six in. Hg., which has been found in many installations where exhaust aspiration was used, would result in reduction in engine horsepower of about 25 per cent.

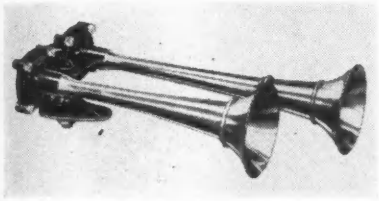
Carburetion in the vertical type of engine has been a major problem. The lower cylinders naturally receive the greater amount of the gasoline when the engine is starting and often receive the excess fuel when the engine is operating; whereas, with the engine in a horizontal position, all runners from the cylinders drain back into the carburetor zone. Therefore, in the vertical engine, greater effort must be made to break up the fuel in the main

(*Turn to page 64, please*)

New Products

New Air Horn Introduced By Bendix-Westinghouse

The Bendix-Westinghouse Automotive Air Brake Co. of Elyria, Ohio, announces a new air horn. Embodying all the salient features of the unit it supersedes in the Bendix-Westinghouse line, the new warning signal presents several innovations in design and construction. The identical rugged construction of the horn it replaces are maintained. This is said to assure long, trouble-free service life, low air consumption and exceptional penetrating qualities. Heavily chrome-plated twin bells return to this postwar model. The change from the old style consists of horizontal alignment of the bells which provides better head clearance and rigidity. Only one hole is necessary to mount the new horn against three of the previous model. The single mounting bolt also functions as the air intake and greatly simplifies installation. Either hand or foot control is available as specified. The trade name ZephAIRtone remains to identify this new horn.



ZephAIRtone horn

New Adjustable Spanner Wrench Sets

Adjustable spanner wrench sets have been added to the JO Line tools manufactured by JO Manufacturing Co. of South Gate, Calif. They come in three sizes which fit the following range of diameters: ¾ in. to 2 in., 1¾ in. to 4 in., and 3½ in. to 6 in. Each wrench set is of forged steel, heat-treated and cadmium plated. A set consists of a handle, removable screw, a key arm, and three pin arms in graduated sizes. The spare pin arms shown fit the middle size wrench. With these tools it is unnecessary to carry several wrenches in a tool box as the spanner wrenches fit the range of diameters specified with any standard mechanic's handle.

JO adjustable spanner wrenches

Steel Balls in 1-MM Size

Production for immediate industry use of high-precision steel balls half the size of a pinhead was announced by SKF Industries, Inc., Front and Erie Sts., Philadelphia, Pa. The minute balls, 1-mm in diameter will be available for delicate instrument bearings and other applications.

Made to extremely fine tolerances, the 1-mm balls average within 0.000,005 in. of being perfectly round and have a diameter variation of 0.000,005 in. or less.

Shipped in lots of 1,000, the balls are weighed on apothecary scales and packed in oil in plastic bottles.

Oakite Pickle Control

Oakite pickle control No. 3, is a new addition to the group of specialized Oakite cleaning, inhibiting, and neutralizing materials. A yellowish-brown, free-flowing powder with a density half that of water, the new material was designed primarily for inhibiting hot sulphuric-acid pickling solutions. It may also be used in mixed sulphuric-hydrochloric baths in which sulphuric acid predominates. Applications, reports Oakite Products, Inc., 28A Thames St., New York 6, N. Y., cover installations pickling many types of ferrous alloys and castings, hot and cold rolled steel, also where pickling is done prior to plating or phosphate coating or where zinc coatings are stripped.

Electroplated Heavy-Duty Engine Bearing

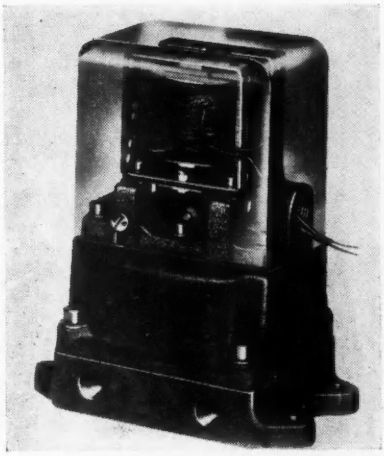
An electroplated heavy-duty engine bearing has been developed by the Cleveland Graphite Bronze Co., Cleveland, Ohio. The bearing, designated as Clevite 77, is intended primarily for heavy-duty applications in gasoline and Diesel engines for trucks, buses and tractors where loads exceed the capacities of previous types of bearings, or where longer bearing life is desired. It is described as an aircraft-type product, consisting of a steel back, an intermediate layer of a special copper-lead alloy, and a thin surface layer of a soft bearing alloy. The thin surface layer is an alloy of three metals which are co-deposited by high-precision automatic electroplating equipment.

The plated layer, about 0.001 in. thick, is said to give a bearing surface of high load-carrying capacity and good fatigue life, and to aid the bearing to break in properly.

Solenoid-Controlled Four-Way Valves

Another new series of four-way solenoid-controlled four-port and five-port valves has just been added to the line of valves made by Numatics, Milford, Mich. These valves can be mounted in any position with either side or bottom pipe connections used.

Two poppet elements, without springs, alternately open and close to pressure and exhaust by "Fluid Lever" air from a solenoid-operated central distributor. These poppet elements control the respective ends of a double-acting air cylinder, with either single or dual pressure. Seat ports and air passages are larger than the inside of standard pipe.



Four-way solenoid-controlled valve made by Numatics

Any working pressure from 0 to 150 psi is handled. One size, low-amperage solenoid with 5/64 in. travel is used for all pipe sizes.

The valve is available with four-port base for single-pressure and with five-port base for dual-pressure service. Both types of bases have side and bottom pipe connections with identical mountings. The valve body and upper structure is standard and will fit either base.

Known as SR-4 series, these valves are available in the following pipe sizes—¼ in., ⅜ in., ½ in., and ¾ in. Larger sizes can be supplied upon request. (*Turn to next page, please*)

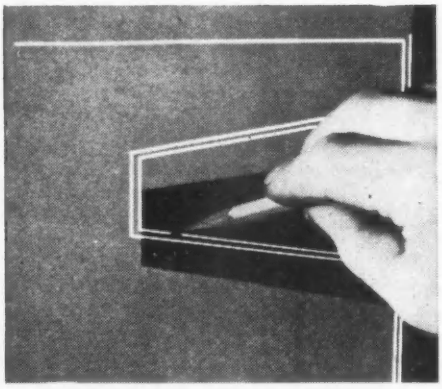
New Scribing Plate

A new engineering material, known as the Kodak green scribing plate, has been developed by the Eastman Kodak Co., Rochester 4, N. Y., for use with optical comparators of the contour projection type.

The plates may be used directly with the contour comparators or as printing masters for photographically duplicating the contour comparator plate. Also, they may be used for making small photo templates on metals, plastics and other materials.

Eliminating the need for using hydrofluoric acid to etch glass plates, the new Kodak product consists of a transparent green-dyed gelatin coating applied to glass. Tolerance lines are scribed on the plate by cutting through the gelatin film.

The Kodak green scribing plate is



Kodak green scribing plate

said to permit easier, more accurate reading. By using a supplemental red light behind the plate, tolerance limits in shadowed areas are brought into sharp relief, showing as red lines against the dark green background. On precision grinders equipped with contour comparators, this permits the machine operator to see exactly how much material must be cut away to attain the desired dimensions.

Where the original scribed pattern is symmetrical, duplicate plates may be printed directly from the original on photographic plates. Since such a copy is a "mirror image," however, unsymmetrical patterns should be scribed in reverse or else the final duplicate should be printed from a master plate prepared from the original.

Light-Weight, Rigid Spiral Tubing

Ready-made, inexpensive concrete-forms and ventilating shafts are revealed among the possible applications of its new spiral tubing by Pratt Industries, Inc., Frankfort, N. Y.

Advantages claimed for the new Pratt product are light weight, extreme rigidity and low cost. On concrete form work the tubing is so cheap that it may be left on finished pillars, piers, and posts. One man can carry 60 ft of the Pratt tubing in 20-ft lengths.

The tubing is spirally formed from metal strip (steel or non-ferrous) with edges joined in a continuous four-ply lock-seam. The spiral "backbone" is said to be the secret of the tubing's rigidity, demonstrated in tests when a two-foot section of tubing, stood on end, supported over a ton without measurable distortion. Wall thickness of the tubing thus tested was 0.030 in.

Thousands of feet of the Pratt product have already gone into air-conditioning ducts. Pulverized-coal circulating lines, stacks, stackliners and flues, backing for rubber-lined pipe are other uses revealed.

Diameters now offered in Pratt tubing range from 2 in. to 8 in., in any length that can be shipped.

Vinylite-Insulated Cable

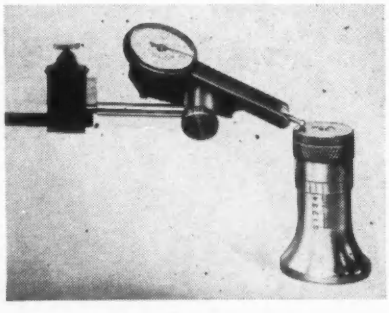
Standard Motor Products, Inc., 3714 Northern Blvd., Long Island City 1, N. Y., is now offering Blue Streak automotive cable with vinylite insulation. This vinylite insulated cable is said to resist the effects of grease, oil, gasoline and "corona." The new Blue Streak cable is available in various colors and gages.

Micro-Planer Gage

The Micro-Planer gage, a new inspection tool, is manufactured by Accurate Machine Products Co., 1640 S. Hobart Blvd., Los Angeles 6, Calif. It uses regular micrometer graduations, and positive protection lock. Its base is parallel to the checking surface.

The tool is designed for setting cutting tools on planers and shapers, in conjunction with gage blocks, and with sine bars in grinding angles, or as an indicator for transferring measurements. It may also be used as a carriage stop for lathes and as a drill press stop, or wherever accurate, controlled measurements are needed.

Constructed of hardened and ground tool steel, the Micro-Planer gage con-

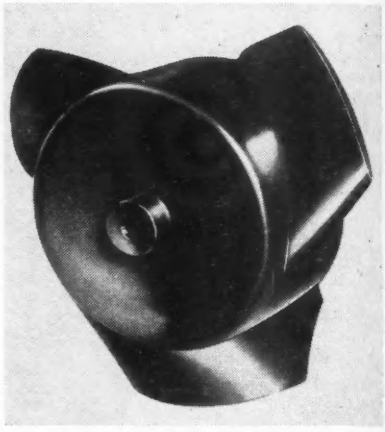


Micro-Planer gage

sists of a base and body with a thimble top. By turning the thimble counter-clockwise, the body rotates on ground micrometer 40-pitch threads, raising in increments of 0.001 in. Turning the thimble clockwise lowers the body. Range of the tool is ½ in. without extrusions and up to 2 in. with extrusions. All measuring surfaces are precision lapped and ground. In the thimble is a compensating adjustment for thread wear. A protection lock in its base prevents the tool from getting out of adjustment after correct setting.

Airfoil Fan Available As Individual Unit

Production of the Evans Airfoil fan assembly as an individual unit for use in mobile air conditioning, heating, and ventilating systems is announced by the Thermo-Aire division of Evans Products Co., 15310 Fullerton, Detroit



Evans Airfoil fan

27, Mich. Previously the Airfoil fan assembly has been manufactured exclusively as a component part of Evans bus and truck heating and ventilating equipment. The Airfoil fan is an axial flow fan molded from a heat and damage resistant thermosetting plastic. It incorporates a straight wing section in its design. The fan is designed for installations where a large amount of air circulation is needed and where fan installation space and power source are limited.

Weight of the Airfoil fan is concen-

Gabriel Brings Out Line of Thermostats

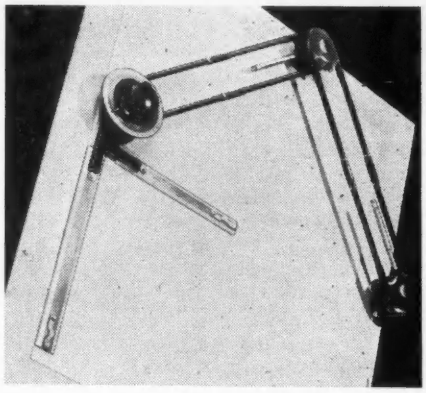
The Gabriel Co., 1407-11 E. 40th St., Cleveland, Ohio, has just brought out a line of engine and heater thermostats. Production is now under way, and they are being delivered in a wide variety of sizes and types.

trated at the hub, creating less inertia for the fan motor to overcome in starting. Airfoil fans are available in sizes ranging from 2 in. to 14 in. in diameter.

According to the manufacturer, design and performance of this fan make possible its use in a wide variety of air circulating systems, including the cooling, heating and ventilating of motor vehicles.

Improved Drafting Machine

The Universal Drafting Machine Co., 1326 W. Third St., Cleveland 14, Ohio, has placed on the market a new model drafting machine, the Universal Boardmaster.



Universal Boardmaster

Boardmaster's "centralized control group" locates *every* operating control at the fingertips of the left hand. All controls are grouped within a 2-in. radius. By the assembly of "packaged" accessory units, a Boardmaster may be converted from a horizontal machine to a vertical machine. The board range of a basic unit is from 0-3 deg.; from 0-7 deg. by addition of a cartridge stabilizer to the upper arm; from 0-20 deg. by adding a stabilizer to the lower arm as well; and from 0-90 deg. by assembly of a weight counterpoising unit. Counterbalancing at any angle is frictionless.

New Heavy Duty Brake Dynamometer

What is said to be one of the largest machines for testing automotive brakes in the world is now in operation at the Bendix brake laboratories. The present automotive equipment at Bendix includes two brake dynamometers, one with a fixed flywheel which depends on the motor for developing the power. The other has an adjustable flywheel and requires almost no power input after the flywheel is rotated up to the speed for energy. The kinetic energy of the flywheel at 2000 r.p.m. is 1,200,000 ft-lb.

The new testing equipment is a combination of the two types using the motor and the inertia of the flywheel for energy. An extra pad or motor base for increased power is installed on the huge dynamometer frame so that an additional motor may be added at any time. The minimum capacity of the new machine starts where the maximum capacity of the smaller ones leaves off.

The new machine consists of several units mounted on a base 30 ft 3.0 in. long by 7.0 ft wide. The first unit is a direct current dynamometer motor which develops from 200 hp to 600 hp at 450 rpm with a maximum of 2000 rpm. Connected to this motor is the 18.25 in. face, 16,685 lb dynamometer flywheel which is made up of movable disks 62.75 in. in diam. This flywheel is designed to duplicate the energy of a minimum 4060 lb and a maximum 40,450 lb road vehicle.

The torque shafts, one 6.0 in. diam and one 4.0 in. diam, are carried in bearings 16 in. apart. These bearings have a capacity of 19,350 lb at 500 rpm. The torque arm is 21.5 in. long and the distance from the center of the flywheel to the center of the torque arm is 80 in.

A Toledo scale, capable of measuring a load of 15,000 lb which is used to measure the developed brake torque, has a maximum capacity of 302,500 lb-in., and is connected to an automatic recording instrument.

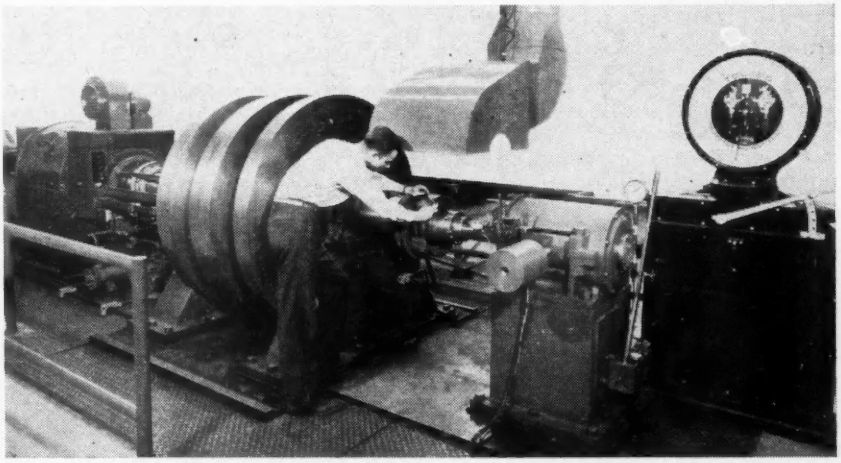
The controls of this powerful machine are mounted on a separate panel and master control desk. Instruments used include chart recording chronograph pens, tachometer generator, electric counter, chronoflex automatic reset timer and counters, electric clocks, and hydraulic pressure gage. Other units not mounted on the main base include a motor generator unit, the motor developing 380 hp at 1200 rpm, and the generator producing the direct current to drive the dynamometer motor, also an amplidyne exciter group consisting of two amplidynes, exciter, and a 20 hp motor.

It is also possible to test an entire axle assembly with the new equipment, if this method of testing becomes desirable. A mounting is provided at the side of the flywheel so that an arm can be bolted directly to the base of the dynamometer, in line with the centerline of the flywheel. An axle assembly can then be mounted on the arm so that the tire of the wheel presses onto the periphery of the flywheel. An air cylinder presses the wheel onto the flywheel with the required force to simulate the portion of the car weight supported by one wheel. The flywheel energy is transferred to the brake through the tire and wheel assembly and is absorbed as the brake brings the flywheel to a stop.

With this new brake testing equipment, it is possible to test brakes up to 300,000 lb-in. torque and the maximum capacity is 38,800,000 ft-lb kinetic energy.

P-81 Jet Fighter Planes Ordered by Army Air Forces

Consolidated Vultee Aircraft Corp. has received an order from the Army Air Forces for an unspecified number of P-81 long-range, jet fighters. The P-81's, first planes powered by a gas turbine engine driving a propeller in the nose and a separate G-E jet engine in the tail, will be built at the Vultee Field division.



Bendix brake testing equipment. Reading from left to right: dynamometer motor, flywheel shaft with automatic pre-selector mechanism for moving the flywheel disks, flywheel brake drum mounted on flywheel shaft, brake mounted on torque shaft and the dynamometer scale

NEWS *of the* Industry

July Production Up 50 Per Cent Over June . . . Car Prices Unchanged Despite Lack of OPA Controls . . . Most Manufacturers Operated at Loss During Second Quarter of Year . . . Few 1947 Models to be Brought Out this Year.

Predictions of a 50 per cent increase in production in July over June probably will come close to realization. The situation is materially better now than it has been, but critical shortages still continue to prohibit anything like capacity production. The trouble is that when one shortage is cleaned up, another crops out, so that it is a succession of different deficiencies. The supply of springs for cushions and seat backs now is pretty well in hand, but nuts and bolts, copper, and certain types of steel continue in short supply.

June production was particularly disappointing. That month the industry built 142,313 passenger cars, against a May total of 152,948. Production of trucks fell off from 74,650 in May to 58,749 in June. The reason for the poor showing was the old story of strikes and shortages which kept most assembly lines down to three or four-day operation. July figures are expected to show an output in the neighborhood of 210,000 to 220,000 cars and between 90,000 and 100,000 trucks. Prospects for increasing production materially above this level are clouded by several uncertainties. One is the duration of the strikes at three major suppliers of fasteners. So far, the industry has been able to scour up enough fastenings to keep going, but with the drain of heavy volume, there is some doubt that enough can be found to support sustained high production. Copper also is becoming increasingly scarce, and there is some concern about a sufficient supply of cold rolled sheet and carbon steel.

Prices Hold Steady Without OPA

Prices of automobiles and trucks were still holding pretty much to the OPA levels three weeks after OPA went into suspended animation. Manufacturers chose to follow a wait-and-see course and dealers did likewise. As a matter of fact, there has been considerable support in the industry for the contention that whether OPA were revived or not, prices by the manufacturers would not go up for the present. George T. Christopher, president of Packard, said that his company will not raise prices if it can attain the volume on which prices were predicated, and if that volume can be exceeded, the price might even be lowered. John Gordon, head of the Cadillac division of G.M., said recently that prices would come down when volume production is reached. However, if dealers choose to recapture their full prewar discount, prices to the buying public would shoot up from $80 to $100 on the lowest priced cars and considerably more on the higher priced makes.

Manufacturers Expected to Show Further Losses in Second Quarter

Although production of cars and trucks during the second quarter of this year was considerably better than during the first three months, when heavy operating losses were suffered by most companies, there is little likelihood that more than one or two automobile manufacturers will show any profit on second quarter operations. Hudson and Willys, both of which have enjoyed relatively good production, are considered to be about the only companies with a chance to be in the black. Ford is almost certain to show a large loss again in the second quarter. Even had the company not suffered a six-weeks shutdown, production during the period was so spotty that a profit would be out of the question. General Motors, while not closed down, operated on very limited schedules and is almost certain to show an operating deficit. Chrysler should make the best showing of the Big Three, since it has made the best production record in the second quarter and also should not have so heavy an overhead as either Ford or G.M. Nash, Packard, and Studebaker also were in low gear production and undoubtedly will show losses. However, production was considerably better in the second quarter for practically all companies, so operating losses should be somewhat lighter than for the first three months of this year.

Several Factors to Influence Date of Model Changeover

The prevailing opinion in Detroit on coming-out time for 1947 models has been generally considered to be early next year. However, what may be a straw in the wind was tossed out by Packard recently when the company announced that it would not introduce new models until well into 1947. Reasons given were that continued production of present models will supply customers with badly needed cars and will avoid a shutdown and unemployment. Another reason not stated, but which possibly has a bearing, is that production this year will not be anywhere near previous expectations, and continuation into next year will help greatly in amortizing die and other tooling costs. Definite decisions of other companies on when to bring out new models are known only in the case of Ford, which stated some time ago that it would be early next year. It has been understood however, that General Motors, Chrysler and the independents (with the exception of Studebaker which already has introduced its '47 line) would come out somewhere near the Ford appearance.

The possibility that the other companies might decide to follow the Packard decision offers interesting speculation. Production certainly has been most disappointing thus far and will fall far short of goals originally projected for this year. Accordingly, a far better showing on tool cost amortization could be made by extending the model run into next year, an especially attractive prospect in view of the heavy losses suffered during the first six months of this year. If the present seller's market still is going strong, the companies could sell all the cars produced, and this possibility is considered good. Actually, the only real reason for a model changeover is to stimulate sales and under present conditions of heavy demand it would appear to be unnecessary and costly to shut down for the changeover until the market demands it. At any rate, production between now and next January and market conditions at that time undoubtedly will have a bearing on new model introductions.

PERSONALS

Recent Appointments Among Automotive and Aviation Manufacturers:

Ford Motor Co.—**John A. Wallace**, Director of Traffic; **Harold E. Joy**, Asst. Purchasing Agent; **Harold T. Youngren**, Director Engineering and **Lewis D. Crusoe**, member of the executive staff.

General Motors Corp., Chevrolet Motor Div.—**Earl W. Pughe**, Plant Mgr., Commercial Body Div., Indianapolis and **Ralph J. Peterson**, Plant Mgr., Commercial Body Div., Buffalo.

General Motors Corp., Pontiac Motor Div.—**M. F. Rummel**, Purchasing Agent.

Chrysler Corp.—**Norman A. Purdy**, General Manager's staff in charge of automobile Quality Inspection Dept.

Hudson Motor Car Co.—**Cecil Loeb**, Washington, D. C., Zone Manager; **Claude Margetts**, Atlanta Zone Manager.

Nash Motors—**Harry E. Cardoze, Jr.**, Asst. Organization Mgr.

The White Motor Co., **Harold O. Hoffman**, elected Asst. Treasurer; **George T. Zack**, elected Asst. Controller.

Twin Coach Co.—**John J. Lee**, Vice-Pres., in charge of Manufacturing.

Gar Wood Industries, Inc., **John J. Palmer**, Manager Newport News plant.

Kaiser-Frazer Corp., **Michael Miller**, Vice-Pres. in charge of procurement and administrative engineering; **J. F. Reis**, Vice-Pres. in charge of fiscal operations; **Anthony A. Akins**, Regional Mgr., Minneapolis and **Roy T. Parsons**, Regional Mgr., Buffalo.

Salsbury Motors, Inc., (subsidiary of Northrop Aircraft, Inc.), **Carl F. Hamilton**, Mgr. of Service and Sales Div.; **Orville E. Mohler**, Sales Mgr. for industrial engine div.

Fairchild Engine and Airplane Corp., Personal Planes Div., **J. Harvey Grey**, Sales and Service Mgr.

Lear, Inc., **Harry E. Rice**, Chief Engineer, Home and Aircraft Radio Div.; **Harry S. Jones**, Chief Engineer, Charge of Research and Development; **William J. Perfield**, Mgr. Engineering, Electro-Mechanical Div.

Goodyear Aircraft Corp., **J. B. Jones**, Mgr. recently organized aerophysics Dept.

McDonnell Aircraft Corp., **George E. Bounds**, Director of Public Relations.

Indian Motocycle Co., **Clarence L. Washburn**, Plant Supt. in charge of Manufacturing.

E. I. duPont deNemours & Co., Inc., Ammonia Dept., **Elmer F. Schumacher**, Director of Sales; **Dr. Harry R. Dittmar**, Asst. Director.

E. I. duPont deNemours & Co., Inc., Plastics Dept., **Dr. Robert M. Evans**, Asst. Mgr. of Industrial Div.; **Calvin R. MacBride**, Asst. Mgr., Products Div.

E. I. duPont deNemours & Co., Inc., Photo Products Dept.; **William M. Springer**, X-Ray Products Mgr.

Ampco Metal, Inc., **Henry A. Mullen**, Manager, Resistance Welding Sales.

The Budd Co., **Charles L. Fike**, Asst. to Donald Alexander, Vice-Pres. in charge of Sales.

The Liquid Carbonic Corp., **George T. Jahnke**, Director of Advertising.

The International Nickel Co., Inc., **R. W. Mason, Jr.**, Metallurgist and consultant to consumers and producers, Development and Research Div.

Elco Lubricant Corp., **J. E. Reagan**, Vice-Pres. and Member of Board of Directors and General Manager of the company.

Lovejoy Tool Co., Inc., **Don H. Proctor**, Chief Sales Engineer.

R. M. Hollingshead Corp., **John R. Flynn**, Comptroller; **Victor M. Mantz**, Director of Research and **Albert E. Moore**, Chief Chemist.

Pennsylvania Salt Co., **Richard T. Nalle**, elected a member of the board of directors.

The Parker Alliance Co., **D. A. Cameron**, Asst. General Sales Mgr.; **J. E. Murphy**, Mgr., Distributor Sales.

Acme Aluminum Alloys, Inc., **Richard C. Crouch**, elected a member of the Board of Directors.

Trade Practice Rules for The Piston Ring Industry

Following an industry-wide conference at Chicago, in April, and a public hearing at Washington, in June, the Federal Trade Commission promulgated a set of Trade Practice Rules for the piston ring industry. The Piston Ring Manufacturers Group had originally requested the promulgation of such rules, and they were unanimously approved by all present members of the Group.

The rules relate to the sale and distribution of piston rings for use as original or replacement equipment in all types of internal combustion engines, steam engines, and compressors. Members of the industry include manufacturers, distributors, jobbers, and others who place piston rings on the market. In the rules, various unfair methods of competition, unfair or deceptive acts or practices, and other trade evils are listed and proscribed.

The unfair trade practices embraced in Group I of the rules are considered to be unfair methods of competition, unfair or deceptive acts or practices, or other illegal practices, prohibited under laws administered by the Federal Trade Commission. The Group I rules apply to: Misbranding; false advertising; deceptive concealment of price charged for so-called premiums; false and misleading price quotations; false invoicing; imitation of trade-marks, trade names, etc.; misuse of word "free," etc.; false, misleading, or deceptive guarantee; coercing purchase of one product as a prerequisite to the purchase of other products; exclusive deals; commercial bribery; "push money," "spiffs," etc.; consignment shipping (under some conditions); defamation of competitors or disparagement of their product; selling below cost; and discrimination.

Compliance with trade practice provisions embraced in Group II of the rules is considered to be conducive to sound business methods, and is to be encouraged and promoted individually or through voluntary cooperation exercised in accordance with existing law. Non-observance of such rules does not *per se* constitute violation of the law. Where, however, the practice of not complying with any such Group II rule is followed in such manner as to result in unfair methods of competition, or unfair or deceptive acts or practices, corrective proceedings may be instituted by the commission as in the case of violation of Group I rules. Trade practices covered by Group II rules are: publishing and circulating independent price lists; maintenance of accurate records; returning of merchandise, and arbitration.

J. F. Winchester Retires

J. F. Winchester, associated with the growth of the Standard Oil Co. of New Jersey for 33 years, is retiring from that company. Recognized throughout the industry as an authority on automotive engineering, and the author of many current articles, Mr. Winchester has elected voluntary retirement under the company's established annuity plan.

CALENDAR

Conventions and Meetings

1st Annual Revival Glidden Tour, Albany, N. Y. Aug. 17-24
SAE Natl. West Coast Trans. and Maint. Meeting, Seattle Aug. 22-24
National Air Races, Cleveland Aug. 30-Sept. 2
Natl. Aeronautic Assoc. of Canada, International Air Show, Toronto Aug. 30-Sept. 7
Natl. Chemical Exposition, Chicago Sept. 9-13
American Chemical Soc., Chicago Semi-Annual Mtg. Sept. 10-14
SAE Natl. Tractor Meeting, Milwaukee, Wis. Sept. 11-12
Natl. Assoc. of Foremen Convention, St. Louis Sept. 12-14
Instrument Society of America, 1st Natl. Show, Pittsburgh Sept. 16-20
SAE Natl. Aeronautic Mtg. & Aircraft Eng. Display, Los Angeles Oct. 3-5
Natl. Aircraft Show, Cleveland Oct. 4-12
1946 Natl. Aviation Clinic, Oklahoma City Oct. 14-17
SAE Natl. Transportation and Maintenance Meeting, Chicago Oct. 16-17
Amer. Soc. Body Eng. Technical Meeting, Detroit Oct. 23-25
SAE Natl. Fuels & Lubricants Mtg., Tulsa Nov. 7-8
French Aero Show, Grand Palais, Paris Nov. 15-Dec. 1
American Welding Society Annual Meeting, Atlantic City Nov. 17-22
Natl. Metal Congress and Exposition, Atlantic City Nov. 18-22
SAE Natl. Air Transport Engineering Mtg., Chicago Dec. 2-4
Natl. Standard Parts Assoc. Conv., Atlantic City Dec. 6-7
Motor & Equip. Wholesalers Assoc. Convention, Atlantic City Dec. 6
Automotive Service Industries Show, Atlantic City Dec. 9-14
Int. Aviation Celebration & Exhibition, El Paso Dec. 12-15

PUBLICATIONS AVAILABLE

Publications listed in this department are obtainable by subscribers through the Editorial Department of AUTOMOTIVE AND AVIATION INDUSTRIES. In making requests give title above the item concerning the publication desired, the date of issue in which it appeared, your name and address, company connection and title.

High-Production Presses

E. W. Bliss Co.—New catalog No. 27-A describes and illustrates Bliss High-Production Presses, ranging in size from 8 to 300 tons, Series 600, engineered to produce automatically large quantity stampings requiring comparatively short and increased strokes per minute. Three different sizes and designs of coil cradles for feeding stock automatically are also described. Parts stamped out of brass, steel and aluminum with progressive and compound dies are also illustrated and data describing Bliss press used for each and the production rate achieved.

High Nickel Alloy Steels

The Carpenter Steel Co.—A comprehensive booklet on the properties and uses of high nickle alloy steels includes a unique diagram showing the three fundamental effects upon which applications are based—temperature permeability, expansion and magnetic permeability. Data is given on the possible uses for which each alloy can be employed. A consolidated table shows the properties for the entire range of nickel content, including tensile strength, hardness values, etc. The booklett also covers low expansion alloys, temperature compensator alloys, glass sealing alloys and high permeability alloys.

Pneumatic Tools

The Aro Equipment Corp.—New 40-page catalog, No. 46, describing the complete line of Aro Pneumatic Tools for industry. Seventy-five standard models are shown with specifications, including many new air tools recently developed and introduced by Aro. A number of tools developed for specialized applications are included, together with descriptive data on a broad range of bits, finders, holders and other accessory equipment.

Metals and Alloys

Westinghouse Electric Corp.—A guide to the properties and applications of 18 recent metallurgical developments is presented in a new 48-page illustrated booklet for engineers and designers. Section I is a detailer discussion of the physical and electrical characteristics of Westinghouse magnetic metals and alloys; Section II, properties and applications of tungsten, molybdenum and Cupaloy are described; Section III, two glass sealing alloys, Kovar A and Dumet, are outlined; Section IV, covers brazing and soldering alloys and Section V, physical and mechanical properties of K-42-B, a high temperature alloy. Tables of physical and electrical characteristics of the new metals and alloys are included.

Cutting Fluids

D. A. Stuart Oil Co.—Technical Bulletin No. 4 discusses types of cutting fluids and methods of testing lubricants and illustrates the function of sulphur and other additives in cutting fluids by test results and graphs.

DoALL Production Short Cuts

The DoALL Company—a new 22-page booklet, DoALL Equals Ten Plus, describes the technique of contour machining and its application in metal working shops. It is designed as a ready reference on machining operations and is a pictorial time study of metal fabricating short cuts.

Castings

Shenango-Penn Mold Co.—New bulletin, Centrifugal and Static Castings of Plain or Alloyed Irons, includes data on the latitude and advantages of the centrifugal process, typical centrifugally cast products, field service, machining facilities and includes a useful chart giving comparative specifications, applications and chemical and physical characteristics of the various standard irons.

Milling Machines

The Cincinnati Milling Machine Co.—Catalog No. M-1429 containing design information, specifications and illustrations of the No. 2 MI Milling Machine.

Welding Electrodes

Jessop Steel Co.—Booklet, Jessop Stainless Steel Welding Electrodes, contains complete information on the selection and application of Jessop stainless electrodes for welding stainless steel. Current range is furnished for each type of rod in varying diameters.

Power Transmission Belting

The B. F. Goodrich Co.—A new folder on its line of power transmission belting for drives of any size, pictures and describes its flat and V-belting for various services, as well as sheaves, belt dressings and the Plylock method of making flat transmission belts endless on the job.

Air Cylinders

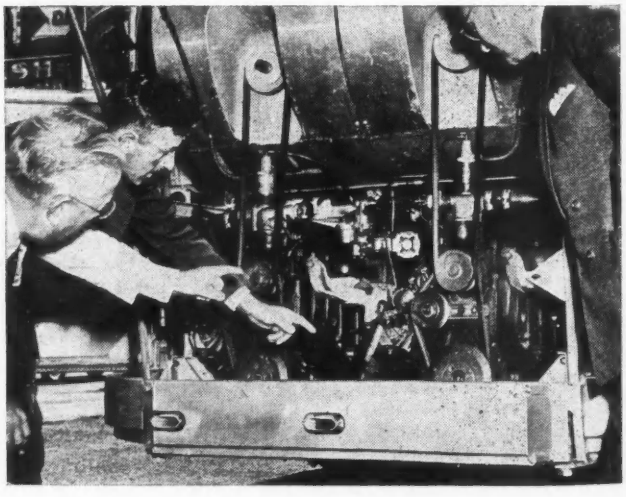
Hanna Engineering Works—Catalog No. 234 gives complete specifications and operating data for Hanna Air Cylinders.

Weekly Production of Cars and Trucks in U.S. and Canada*

Week ending	1946	Corresponding Week in 1941
Jan. 5.....	13,920	76,690
12.....	23,340	115,935
19.....	28,465	124,025
26.....	29,410	121,948
Feb. 2.....	29,295	124,400
9.....	23,785	127,675
16.....	21,555	127,510
23.....	19,410	127,740
Mar. 2.....	17,575	126,550
9.....	23,050	125,915
16.....	35,020	131,410
23.....	37,285	123,805
30.....	43,070	124,165
Apr. 6.....	47,735	116,255
13.....	49,425	99,260
20.....	57,565	99,945
27.....	64,620	108,165
May 4.....	67,060	130,610
11.....	71,335	132,380
18.....	48,565	127,255
25.....	53,020	133,560
June 1.....	31,895	106,395
8.....	43,175	133,645
15.....	50,206	134,682
22.....	54,475	133,565
29.....	64,015	127,926
July 6.....	45,175	96,457
13.....	74,015	114,318
20.....	78,995	109,912
Totals.....	1,191,881	3,482,098

*Compiled by Ward's Automotive Reports.

Bus Has Two Chevrolet Engines



This is the rear view of the pilot model of a passenger bus, designed and built by the Flexible Co., Loudonville, Ohio, and powered by two 93 - hp Chevrolet Loadmaster truck engines. Known as the dual-engine Clipper, the bus is planned for long - distance and suburban over - the - road passenger runs.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE *and* AVIATION INDUSTRIES

Further wide fluctuations of general business activity have been indicated. The *New York Times* index for the week ended July 6 stands at 123.3, as compared with 133.6 for the preceding week and 122.2 a year ago.

Sales of department stores, as reported by the Federal Reserve Board, for the week ended July 13 equaled 210 per cent of the 1935-39 average, as compared with 192 in the preceding week. Sales were 25 per cent above the corresponding distribution in 1945, as against a like advance of 26 per cent for the week before. The total in 1946 so far reported is 28 per cent greater than the comparable sum in 1945.

Electric power production increased by more than the usual season amount during the week ended July 13. The output was 3.2 per cent below the comparable amount last year, as compared with a similar recession of 6.0 per cent in the preceding week.

Railway freight loadings during the same week totaled 895,080 cars, 31.7 per cent more than the figure for the week before and 1.3 per cent above the corresponding number a year ago.

Crude oil production in the week ended July 13 averaged 4,934,400 barrels daily, 28,950 barrels more than the average for the preceding week but 9,600 barrels below the comparable figure in 1945.

Bituminous coal and lignite production during the week ended July 6, reflecting the influence of vacations and a holiday, was estimated at 6,570,000 tons, as compared with 12,380,000 tons in the week before and 8,050,00 tons a year ago. The output in 1946 so far reported is 2.9 per cent below the corresponding production in 1945.

Civil engineering construction volume reported for the week ended July 18 by *Engineering News-Record*, $130,410,000, is 13 per cent less than the figure for the preceding week but 160 per cent above that recorded a year ago. The total shown for twenty-nine weeks this year is 202 per cent more than the comparable sum in 1945. The increase in private construction is 542 per cent, and the advance in public construction is 65 per cent.

The wholesale price index of the Bureau of Labor Statistics for the week ended July 13 is 120.7 per cent of the 1926 average, as compared with 117.2 for the preceding week and 105.6 a year ago.

Member bank reserves increased $79,000,000 during the week ended July 17. Underlying changes thus reflected include a decline of $124,000,000 in Reserve bank credit and a decrease of $151,000,000 in Treasury deposits with Federal Reserve banks, accompanied by a decline of $94,000,000 in money in circulation.

Total loans and investments of reporting member banks declined $434,000,000 during the week ended July 10. A rise of $106,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $7,717,000,000, shows a net increase of $1,789,000,000 in twelve months.

Britain Celebrates Golden Jubilee

Employing the slogan, "Vital to the Life of the Nation," Great Britain is beginning a celebration of the motor industry's Golden Jubilee this year.

The celebration, being directed by the Motor Industry's Jubilee Committee, began July 18 and continues through Nov. 20.

On July 18, the Rt. Hon. John Wilmot, M. P., Minister of Supply, officiated at the opening of the headquarters of Britain's Motor Industry at 148 Piccadilly. This building, formerly the town house of Baron Lionel de Rothschild, will henceforth house the activities of the Society of Motor Manufacturers and Traders, the organization which has represented British motor manufacturers since 1902.

The official opening of the new headquarters was followed on July 19 by the opening of the Jubilee Exhibition, "Pageant of 50 Years of Progress," which will be open to the public at the Piccadilly headquarters until Aug. 10.

This exhibition will portray fifty years of automotive history by means of scale models of motor vehicles built from 1896 onwards. By means of animated displays and a special documentary film, "The Nation's Vital Life Line," visitors will be able to trace the growth of the industry since Nov. 14, 1896, the historic date when the notorious "Locomotives on the Highways Act" of 1878 was repealed and which British motorists annually celebrate as "Liberty Day."

After its run in London, the exhibition will be taken on tour, showing at Cardiff from Aug. 26 to Sept. 7. Birmingham from Sept. 20 to 26, Coventry from Oct. 4 to 9, and Manchester from Oct. 21 to Nov. 2.

On July 27 the London Cavalcade, a pageant of motor vehicles, toured the metropolis. No less than 450 vehicles, each typifying the year of its "vintage" from 1896 to 1946, along with motor transport vehicles of all kinds, motorized equipment of the Army and Royal Air Force, and farm tractors and other automotive contributions to agriculture, paraded through the city accompanied by prize bands of the motor industry.

New Die Casting Plant Planned by ALCOA

Application has been filed with the Civilian Production Administration by Aluminum Co. of America for permission to erect a plant in Des Plaines, Ill., for the manufacture of aluminum die castings.

The plant would be built on a 35-acre site at Wolf and Algonquin Roads, Des Plaines, and would include manufacturing, service and office buildings. According to present plans, the plant would have floor space of approximately 190,000 sq ft, and would employ 400 to 500 workers when manufacturing operations get under way. Possible future expansion might nearly double the plant area and employment figures.

AC Spark Plug Division To Manufacture Plastic Parts

Indicative of the trouble automobile companies are experiencing in getting suppliers to provide needed automotive parts is the decision of the AC Spark Plug Div. of G.M. to enter into manufacture of plastic parts. Sources from which these parts were previously bought are being retained until the new department now being set up can meet assembly needs. At the outset, production will be limited to parts used in the making of instruments and instrument panels. The division has been experimenting with plastic manufacture for the past five years in a limited way. It has produced successfully plastic odometer wheels and cams for bombsights. Suppliers are said to be reluctant to take contracts for close tolerance parts needed in the manufacture of cars when they can use facilities for production of toys, toothbrushes and similar items which have no set tolerances. Straight compression molding will be used for parts requiring high pressure molding. Some large presses used for aircraft spark plug insulators have been remodeled for this work. Other parts will be made by the injection molding process. Production will be on a three shift basis eventually.

Central Foundry Division Set Up By General Motors

General Motors has organized a Central Foundry Division to provide additional foundry services to any of the Corporation's divisions which require it. It will be included in the General Engine Group under jurisdiction of H. K. Evans, vice-president. Initial operations will be at Lockport, N. Y., where the grey iron foundry, now operated by Harrison Radiator Division, will be taken over. The foundry is being revamped and new equipment installed for production of shock absorber castings.

Obituary

Leslie B. Davis, secretary-treasurer of the Perfect Circle Co., Hagerstown, Ind., for the past 17 years, died on July 14.

John W. Peterson, technical sales service manager of the Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., died of a heart attack at his home during the night of July 16.

Carl E. Bolte Appointed

Carl E. Bolte, formerly president and general manager of the Slater Mill & Elevator Co., Slater, Mo., has been appointed executive secretary of the National Lubricating Grease Institute.

BLMA Elects Officers, Ratifies New Constitution

A new constitution streamlining the Brake Lining Manufacturers' Association, Inc., to bring all of its resources behind its new programs of safety education and standardization of friction materials that was proposed early this month at a convention at Absecon, N. J., has been ratified by the membership. The announcement was made today by Robert B. Davis, newly elected president, at his offices where he is executive officer of the Raybestos Division of Raybestos-Manhattan, Inc., Bridgeport, Conn.

Organized in 1924, the association was first incorporated in 1927 as the Asbestos Brake Lining Association. It was re-incorporated under its present name in 1933 when the present executive headquarters were established at 370 Lexington Ave., New York. For the past two years James S. Doyle, automotive staff manager of Johns-Manville Corporation, New York, has served as president and directed the plans for the reorganization under another constitution.

The new constitution provides for a board of directors, restricted to chief executives, which chooses its president and vice-president from the board, a treasurer from the membership at large and an executive vice-president and secretary to carry on association affairs.

Chosen for the vice-presidency was Thomas L. Gatke, president of the Gatke Corp., Chicago; for treasurer, William H. Dunn, comptroller of Raybestos-Manhattan, Inc., Passaic, N. J.; for executive vice-president, T. E. Allen, formerly of the American Automobile Association, Washington, D. C., and for secretary, Miss Harriet Duschek, for many years in the headquarters.

The principal effectiveness of the new constitution is in the executive powers given the board of directors for the direction of many improvements within the industry, including standardization of brake lining sizes.

Approximate Prices of Kaiser and Frazer Cars

Prices for the Kaiser and Frazer automobiles will be announced on Aug. 15, according to Joseph W. Frazer, president of Kaiser-Frazer Corporation. He said that he hopes production costs will allow a price of about $1650 for the Frazer and indicated that there is a good chance of hitting that figure. Negotiations with OPA continued during the period when that agency was legally out of existence, so that in any event no time would be lost in getting approval of prices. The Kaiser will be priced at between $150 and $200 under the Frazer. The two cars are similar mechanically, but differ principally in appointments. The Frazer has foam rubber cushions, wider and heavier bumpers, more elaborate grilles, and better quality of upholstery. An overdrive also is available as optional equipment on the Frazer.

Rogers Diesel and Aircraft Corp. Changes Name

Rogers Diesel and Aircraft Corp. has changed its name to R. B. Rogers Companies, Inc., it was announced by Caldwell Baker, vice-president.

The Rogers group of interests includes the Indian Motocycle Co. and the Ideal Power Lawn Mower Co. of Springfield, Mass.; Hill Diesel Engine Co. of Lansing, Mich.; Edwards Co. of Sanford, N. C.; Fox Industries of Philadelphia; Rogers International Corp. of New York, and others.

Motor Vehicle Factory Sales

Automobile Manufacturers Association, Detroit

1946 Motor Vehicle Factory Sales, by Months, U. S. Plants

1946	Passenger Cars	Motor Trucks and Commercial Cars	Total
January	56,367	45,461	101,828
February	57,782	35,179	92,961
March	85,810	38,160	123,970
April	130,816	81,710	212,526
May	168,759	76,162	244,921
June	141,090	60,812	201,902
6 Months	640,624	337,484	978,108

Factory Sales to Domestic and Foreign Markets, by Months

	Passenger Cars		Motor Trucks and Commercial Cars	
1946	Domestic Market	Foreign Markets	Domestic Market	Foreign Markets
January	53,441	2,926	38,387	7,094
February	54,109	3,673	26,938	8,241
March	80,239	5,571	29,538	8,622
April	124,052	6,764	63,374	18,336
May	160,059	8,700	60,688	15,474
June	131,284	9,806	50,998	9,814
6 Months	603,184	37,440	269,903	67,581

Motor Truck Factory Sales by Gross Vehicle Weight

TOTAL

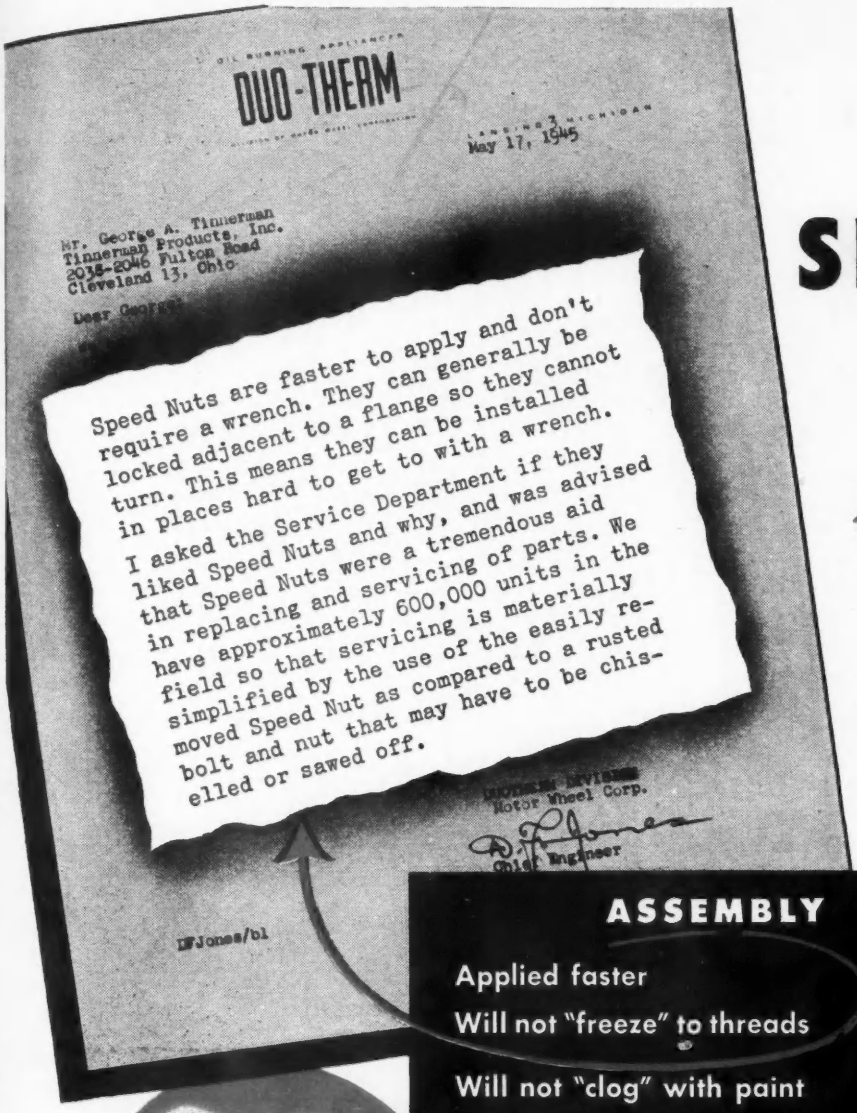
1946 GVW (lb.)	January	February	March	April	May	June	6 Months
5,000 & less	18,535	13,758	16,821	26,925	26,209	32,890	135,138
5,001–10,000	3,877	3,102	3,064	20,136	14,482	6,792	51,453
10,001–14,000	9,058	9,434	7,389	19,553	23,694	12,855	81,983
14,001–16,000	8,499	4,624	7,791	9,788	6,176	3,457	40,335
16,001–19,500	1,607	1,151	411	1,711	2,002	1,556	8,438
19,501–26,000	2,136	1,760	1,223	1,691	1,729	1,469	10,008
Over 26,000	1,282	1,085	937	958	1,081	1,019	6,362
Total	44,994	34,914	37,636	80,762	75,373	60,038	333,717

DOMESTIC MARKET

5,000 & less	17,331	11,822	14,433	23,956	23,122	29,657	120,321
5,001–10,000	3,151	2,785	2,343	11,755	8,683	4,898	33,615
10,001–14,000	6,713	5,479	4,388	15,731	19,563	9,799	61,673
14,001–16,000	6,457	3,156	5,630	7,105	4,360	2,377	29,085
16,001–19,500	1,121	869	325	1,516	1,635	1,279	6,745
19,501–26,000	1,950	1,569	1,104	1,547	1,576	1,309	9,055
Over 26,000	1,208	1,028	872	910	1,008	928	5,954
Total	37,931	26,708	29,095	62,520	59,947	50,247	266,448

FOREIGN MARKETS

5,000 & less	1,204	1,936	2,388	2,969	3,087	3,233	14,817
5,001–10,000	726	317	721	8,381	5,799	1,894	17,838
10,001–14,000	2,345	3,955	3,001	3,822	4,131	3,056	20,310
14,001–16,000	2,042	1,468	2,161	2,683	1,816	1,080	11,250
16,001–19,500	486	282	86	195	367	277	1,693
19,501–26,000	186	191	119	144	153	160	953
Over 26,000	74	57	65	48	73	91	408
Total	7,063	8,206	8,541	18,242	15,426	9,791	67,289



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No. 2 in a series, "The Customer Talks"

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- Will not "clog" with paint
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- Eliminate handling of material
- Perform multiple functions
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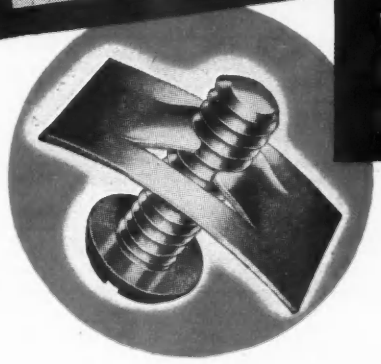

Let Duo-Therm's Chief Engineer, D. F. Jones, tell you what *he* thinks. His letter above leaves no doubt about the advantages of SPEED NUTS in the manufacture and servicing of hundreds of thousands of fuel oil heaters by the Duo-Therm Division of Motor Wheel Corporation.

SPEED NUTS help keep down the costs on Duo-Therm's modernized assembly lines. And the ease with which SPEED NUTS are removed greatly speeds up servicing their units in the field.

Why postpone the improvement of *your* product assembly? Eliminate waste motions, unnecessary parts and useless weight by changing to SPEED NUTS. Send your complete assembly details when writing for samples as SPEED NUTS are made in over 3,000 shapes and sizes.

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*Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

New Truck Registrations*

1946 New Truck Registrations May Surpass 1941 Record

With this issue of AUTOMOTIVE AND AVIATION INDUSTRIES we are once again able to renew for our readers the pre-war service of providing new truck registrations by makes and by months. This service which was discontinued in March, 1942, will once again be a special monthly feature of AUTOMOTIVE AND AVIATION INDUSTRIES.

During the first four months of 1946 there were 128,295 new trucks registered throughout the United States. For the same period of 1941, the last complete year for which new truck registrations are available, there were 227,603 new trucks registered, indicating a decline for 1946 from 1941 of about 43.5 per cent. However, on the basis of partial returns for the month of May this rate of decline is rapidly decreasing as 41 state returns for that month are running behind 1941 by only slightly over 16 per cent.

Of the 19 truck manufacturers whose new registrations are reported by R. L. Polk & Co., four companies, Chevrolet, Dodge, Ford and International were responsible for approximately 76 per cent of the new registrations. Ford is in the lead with 39,196 trucks registered in the first four months of the year. Dodge is running second with 26,308, International third with 18,524 and Chevrolet fourth with 13,449. In 1941 Chevrolet was in the lead followed by Ford, International and Dodge in the order named.

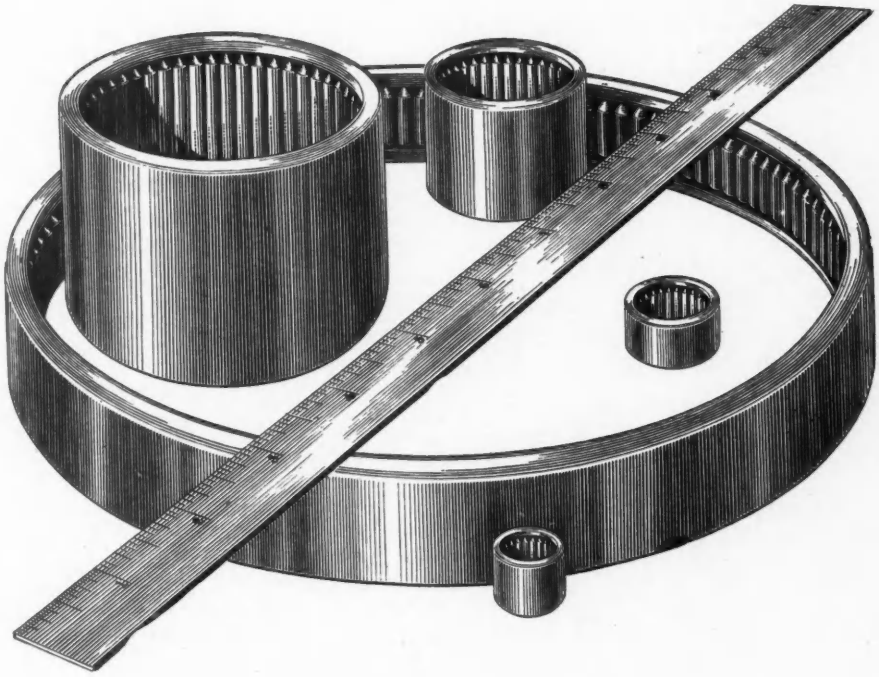
While the volume producers of trucks all show a decline in new registrations for the first four months of this year as compared with 1941, with the exception of Dodge who has a gain of about 6300 units, many of the smaller manufacturers indicate material gains. Willys shows a 1510 per cent increase, Reo 420 per cent increase, Federal 139 per cent and Studebaker 137 per cent. Other companies with material gains are Autocar, Brockway, Divco, F.W.D., Hudson and Sterling. Diamond T and Mack have about the same number of new registrations for this year as compared with 1941.

Given freedom from strikes and an ample supply of parts and supplies there is every reason to believe that before 1946 comes to an end sales for the year will have passed those for the peak year of 1941 and a new record will have been established.

First Four Months of 1946 and 1941 Compared

Make	Year	January, February, March	April	FOUR MONTHS Units	% Change 1946 over 1941	Per Cent of Total	May (41 States†)
Autocar	1946	967	320	1,287	+ 62.0	1.00	231
	1941	543	250	793	.....	.35	160
Brockway	1946	851	311	1,162	+ 69.4	.91	209
	1941	458	229	687	.....	.30	130
Chevrolet	1946	7,045	6,404	13,449	− 82.2	10.48	11,128
	1941	52,632	22,497	75,129	.....	33.01	14,915
Diamond T	1946	1,480	691	2,171	none	1.69	282
	1941	1,466	701	2,167	.....	.95	296
Divco	1946	676	389	1,065	+ 45.5	.83	319
	1941	516	217	733	.....	.32	154
Dodge	1946	17,969	8,339	26,308	+ 31.5	20.51	6,587
	1941	13,991	6,038	20,029	.....	8.80	4,180
Federal	1946	890	315	1,205	+ 138.5	.94	347
	1941	368	137	505	.....	.22	128
Ford	1946	27,952	11,244	39,196	− 42.2	30.55	6,788
	1941	50,990	16,789	67,779	.....	29.78	12,003
F.W.D.	1946	114	53	167	+ 79.6	.13	30
	1941	75	18	93	.....	.04	7
G.M.C.	1946	1,460	954	2,414	− 83.5	1.88	1,393
	1941	10,456	4,267	14,723	.....	6.47	2,745
Hudson	1946	311	241	552	+ 80.0	.43	226
	1941	213	94	307	.....	.13	45
International	1946	14,279	4,245	18,524	− 42.0	14.44	4,076
	1941	22,941	9,129	32,070	.....	14.09	6,256
Mack	1946	2,398	546	2,944	none	2.29	306
	1941	2,001	931	2,932	.....	1.29	639
Plymouth	1946	3	1	4	.....	....	1
	1941	2,636	1,041	3,677	.....	1.62	739
Reo	1946	1,540	858	2,398	+ 420.0	1.87	473
	1941	307	154	461	.....	.20	107
Sterling	1946	135	57	192	+ 28.0	.15	24
	1941	102	48	150	.....	.07	26
Studebaker	1946	1,785	1,348	3,133	+ 137.0	2.44	1,465
	1941	845	475	1,320	.....	.58	283
White	1946	2,109	648	2,757	− 9.2	2.15	711
	1941	2,122	918	3,040	.....	1.34	594
Willys	1946	4,692	3,638	8,330	+1510.0	6.49	1,777
	1941	332	186	518	.....	.23	159
Miscellaneous	1946	719	318	1,037	+ 111.0	.82	174
	1941	373	117	490	.....	.21	65
Total	1946	87,375	40,920	128,295	− 43.3	100.00	36,547
	1941	163,367	64,236	227,603	.....	100.00	43,631

* Data from R. L. Polk & Co.
† Missing states are California, Illinois, Missouri, New York, Oklahoma, Texas, Vermont, and Wisconsin.



How Big Should a Needle Bearing Be?

...Big enough to carry the load. But whatever the actual size required—the Torrington Needle Bearing is the most *compact* anti-friction bearing unit ever devised.

In relation to its radial load capacity it has the smallest O.D. of *any* comparable anti-friction unit—an important design advantage from the standpoint of space-savings and weight reduction.

Experience in hundreds of different applications has demonstrated the practical advantages of this high unit load capacity in terms of design improvement, increased operating efficiency, and manufacturing economy.

Ask our engineering department to translate these Needle Bearing features in terms of *your own design requirements*...to show you how *small* a bearing can be to give you all these advantages. Your inquiry involves no obligation.

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TORRINGTON NEEDLE BEARINGS

Aviation Gas Turbine Installation Problems

By M. C. BENEDICT
Aviation Gas Turbine Division
Westinghouse Electric Corp.

ALL SUCCESSFUL airplane designs have at least one feature in common. This feature is that the engine delivers its predicted performance or better when coordinated with an installation arrangement which satisfies the specified engine and airplane operating conditions safely and efficiently.

Proper location of the inlet air duct is one of the major problems. The ratio of duct inlet area to engine inlet area selected should provide the best compromise performance to suit the operational requirements of the airplane. The result will usually be a slightly diffusing duct which will not penalize either take-off or high speed performance. The ducts should have very smooth inner surfaces, gradual diffusion and no sharp changes in section. The inlet should be designed to prevent flow separation at applicable angles of attack and flight speeds. A flexible connection is required at the engine inlet to provide for engine expansion. On multi-engine aircraft the inlet duct should include an air shut-off valve to prevent the engine from windmilling when cut-out in flight.

A three-point mounting system of turbo-jet engines uses simple rugged supports. The front support is a universal which takes vertical loads only, but also allows the engine to expand lengthwise and move laterally. The two rear trunnions located near the center of gravity, take all fore and aft, side and torque loads. One of the brackets must be a slip fit on the trunnion to allow the engine to expand and to prevent structural loads from being transmitted through the engine. The vibratory frequencies imposed on the engine mounts are usually well above the range of the natural modes of vibration of the aircraft mounting system and structure. In addition, the vibratory loads in all directions are so small that vibration isolators or absorbers are not required. This eliminates the very troublesome problems of providing for engine motion in the design of cowling, inlet ducting, exhaust extensions, ejectors, and so forth. The simplicity of the mounting trunnions is well adapted to design of quick disconnecting mounting provisions to facilitate rapid engine changes.

To insure proper engine operation, the ambient temperature around the engine accessories should not exceed the allowable limit of ambient temperature for the electrical components. Pressure drop is maintained across the engine compartment by means of ram in flight and ejector action on the ground. In addition to cooling the engine, the airframe structure must be protected from engine heat. Damaging temperatures to all-metal structure are not encountered until the region of the combustion chamber is reached. From this point aft, it is necessary to protect adjacent structure if the combination of distance from the engine and cooling air flow does not keep the structure below the critical temperature for the material used.

Foremen's Association To Hold Convention

The National Association of Foremen will hold its first convention in four years at St. Louis, Mo., Sept. 12 to 14. Seventeen sectional conferences will be held to discuss all phases of management problems faced by industry today. Among the principal speakers scheduled to address the convention are C. F. Kettering, vice-president of General Motors; Charles R. Hook, president of American Rolling Mill Co., and Harry Woodhead, president of Consolidated Vultee Aircraft Corp.

Kellett Brings Out Twin-Engine Helicopter

Kellett Aircraft Corp., North Wales, Pa., is offering to air transport operators and others interested in short-haul air transport what is expected to be the world's first commercial twin-engine helicopter. This helicopter will be capable of carrying ten passengers, in addition to a pilot and co-pilot, or will handle cargo loads of one ton or more.

With a gross weight of 11,600 lb and two 550-hp Continental engines, the helicopter, designated the KH-2 type, will operate from landing areas the size of a baseball diamond. Initially it will be offered to transport operators supplying air transport between midcity or residential areas and outlying airports used by commercial airlines. Other shuttle service and short-haul operations are being developed through conferences with industrial users.

Based in part on designs arising from the construction of the XR-10 twin-engine helicopter for the Army Air Forces, the all-metal KH-2 model will offer operation on only one engine in emergencies and synchronized, two-rotor construction which is expected to afford excellent stability and vibration characteristics.

Labor's Stake In Freedom

(*Continued from page* 15)

destroying competitive enterprise and individual freedom. Business leaders know that when that happens labor will be the first to suffer.

Those in organized labor especially should be reminded that freedom is indivisible. When a part is taken away, that which remains is no longer freedom. Nor can the freedom of one group be restrained without restricting the freedom of all. Business management cannot be regimented without labor soon finding itself in chains. Once industrial freedom is lost, political freedom, religious freedom and freedom of press, radio and expression, will all fall. Organized labor's stake in freedom therefore is its very existence. Surely it is unthinkable that in the light which shines through this twentieth century, a great progressive people will be beguiled into turning back to the ways of controlled economies and dictated social progress.

The Beechcraft Bonanza

(*Continued from page* 23)

Rate of climb indicator—Eclipse-Pioneer.
Compass—Eclipse-Pioneer.
Sweep-second clock—Elgin, 7 jewel.
Outside air temp gage—C-12A (modified).

Standard Engine Instruments

Tachometer—Eclipse-Pioneer.
Manifold pressure gage—Eclipse-Pioneer.
Engine gage cluster unit—Eclipse-Pioneer (with fuel pressure, fuel quantity, oil temperature, oil pressure, ammeter, and cylinder head temperature gage).

Lights

Two landing lights in wings—General Electric No. 4522.
Position and tail lights—Grimes.
Cabin dome and ultra-violet instrument lights—Beech.
Landing gear and flap position lights.

Controls

Conventional three control system, rudder pedals on both sides, adjustable, with right hand set capable of being folded out of way. Toe brake pedals standard on left side. Throw-over wheel with two height positions available on each side at option of pilot. (Dual wheel optional at extra cost.) Elevator tabs adjustable by control wheel below panel. Beech design creep-proof micrometer adjustment throttle control. Engine cowl flap control. Carburetor air control for cold or warm air. Ventilation and heating controls. Radio controls directly in front of pilot. Electric landing gear and flap controls and emergency manual landing gear control.

Minor Novel Features

Main wheel doors close when wheels are down to keep out mud and dirt and prevent buffeting damage.
Nose wheel tire has mud scraper to keep dirt off bottom of fuselage.
Retractable step to make cabin entrance easy.

AAF Plans for the Future

(*Continued from page* 31)

nical quality of the AAF is the establishment of The Air Institute of Technology at Air Materiel Command Headquarters, Wright Field, Ohio, recently announced by Lt. Gen. N. F. Twining, AMC commanding general. Initially set up to graduate from 200 to 350 officers yearly, the purpose of the school is to furnish a nucleus of highly trained officers to meet the AAF's technical education needs of the future. The school is being organized at Wright Field so that present existing facilities of the aeronautical development center there will be available for use with least additional cost to the Government. It will be staffed principally by civilian professors and instructors expert in the fields of engineering and logistics. First classes will convene Sept. 3, 1946.

Brig. Gen. M. E. Gross is military commandant of the school. Deans of the colleges will be named by Gen. Gross upon recommendations from an advisory council. Ezra Kotcher, associated with the Materiel Command for 18 years and also with the former Air Corps Engineering School, will be director of the Institute. The school will be housed in one of the laboratory buildings at Wright Field until a building program planned for the Institute can be completed.

Bachelor of Science or Bachelor of Business Management degrees, varying with the course of study, will be awarded graduates of the two-year course when the school is accredited by the Society for the Promotion of Engineering Education. Enrollees in the school may achieve as much as a Doctor of Science degree. Specifically, the Institute will provide training which will assure scientific research, design, and technical development of AAF equipment and the efficient execution of procurement, supply, maintenance and service responsibilities assigned to the AAF. Instruction in nuclear physics and electronics is included in the courses planned.

Present and Future Projects

Brig. Gen. Craigie, head of engineering at Wright Field, has disclosed an impressive list of research and development projects being sponsored by the Air Materiel Command. Many of these projects are only in the planning stage. Some of them are not intended to produce finished aircraft, power plants, etc., being contracts with various companies and universities for scientific and engineering studies of component parts and phenomena affecting these parts. Others of the projects are being carried forward to completion even now. The new fighter type airplanes are numerous, the designations already being above 90. The latest about which information has been released is the XP-84. Its designer and builder, Republic Aviation Corp., has dubbed it the "Thunderjet." Its speed is reported as more than 590 mph, and service range and ceiling 1000 miles and 40,000 ft, respectively. It is about the same size as the Lockheed P-80, having a wing span of 36.5 ft and an overall length of 37 ft. The weight is approximately 1000 lb heavier than the P-80, being close to 9000 lb. It is powered by a General Electric axial flow jet engine. The bubble canopy is electrically operated and permits the pilot to jettison the assembly in case of emergency exit at high speeds. A specially constructed pilot ejection seat is also provided for this purpose. The rear section of the fuselage is quickly removable to permit complete replacement of the engine in 50 min. Tests of the first XP-84 are still underway at the AAF test base at Muroc Dry Lake, Cal. A contract with Republic to produce in excess of 100 Thunderjets in the coming year was disclosed.

Another new jet just recently revealed is the XP-79B, a single-place flying wing fighter plane. It is in the over 500 mph speed class, and has the distinctive feature that the pilot flies the aircraft while lying in a prone position. It is powered by two Westinghouse model 19B jet units. Twin fins are mounted on top of the wing, and rudder assist ducts aid in operating split flap rudders at the wing tips. The wing span of the small craft is 38 ft, and the length is 14 ft. The plane is said to be highly maneuverable, and the prone position of the pilot allows him to withstand more G's without blacking out. Other jet fighters being built include two single engine planes, the North American XP-86 and the Curtiss Wright XP-87, but no details can be published as yet.

Five new jet bombers are being developed. Their designations are XB-45, 46, 47, 48, and 49. The XB-45 is under construction by North American Aviation, Inc., the XB-46 by the Consolidated Vultee Aircraft Corp. Boeing Aircraft Corp. is making the XB-47, and the XB-48 is being constructed by the Glenn L. Martin Co. The XB-49 is planned by the Northrop Aircraft Corp. and it is the jet propelled version of XB-35 Flying Wing. These craft will embody many novel features, among which is grouped jet units. As many as three power units will be installed in the same nacelle. Wing sweep-back, and all of the other tricks to reduce drag at high speeds, will be used in the various models.

XB-36, the AAF's new heavy bomber built by Consolidated Vultee, is being readied for its initial ground tests. It is the first of the so-called "Ten thousand miles, ten thousand pound bombers." The 10,000 lb refers to the bomb load that can be carried over this great distance. This pusher type airplane is powered by six 28-cylinder Pratt and Whitney engines, has a wing span of 230 ft and a fuselage length of 163 ft. Flight tests are scheduled for late summer.

Wright Field experimental laboratories are doing work on the little publicized ram-jet type of high-speed jet aircraft engine. The ram jet represents an ultimate in simplicity, being mainly a duct fitted with a fuel system, and having no moving parts such as compressor and turbine rotors. This type power unit is not effective at low speeds. Therefore a plane or missile equipped with such a unit must have some other means of attaining a high speed before the ram jet takes over. The ram jet has already been flight tested on existing airplanes and projects for larger and higher speed units are under development. The possible application of the ram jet lies in three fields. Its greatest suitability is for supersonic aircraft, either piloted or pilotless. Because of its light weight and ease of fabrication, it also may be used for subsonic expendable missiles. The third possible application is for rotary wing aircraft where rotor wing tip speeds may approach the speeds desired for ram jet operation and where the economy of engine weight and freedom from power transmission problems compensate for a higher fuel economy.

Much work is being done by the AAF to determine the effect of extreme altitudes (60,000 to 80,000 ft and even higher) on men, materials, and machines. In conjunction with this work, a B-29 "flying laboratory" is making flights at 15,000, 25,000, and 35,000 ft levels and studies are being made of the effect of cosmic rays on chemicals and metals. Presumably the results obtained can be extrapolated to give some idea of the effect at the higher altitudes. Dr. Lyman J. Briggs, chairman of the research committee of the National Geographic Society, and Dr. W. F. G. Swann, director of the Bartol Research Foundation, are civilian supervisors of the flights.

Three devices, unrevealed until recently, were developed to save pilots forced to leave an airplane traveling at very high speeds at extremely high altitudes. These are the ejector seat, the special ribbon parachute, and aneroid automatic parachute opener. These devices are expected to take some of the personal risk out of the aircraft development planned for the immediate future.

Transonic Flight Test Airplane

Wright Field has a number of re-

(*Turn to page* 60, *please*)

search projects advanced to the point of contracts being let to various aircraft companies to build airplanes for transonic and supersonic research. The project of this group that appears to be the farthest advanced is the XS-1, a rocket powered single seat airplane. Testing is planned in which the pilot of this tiny flying laboratory will take it up through the transonic speed range, roughly considered 600 to 900 mph, and reach a final speed approximately equal to a Mach number of two. The XS-1 looks somewhat like the German ME 163 rocket fighter plane. It has a pressurized cabin which can be ejected from the airplane, with pilot and all, in case of disability. At the proper altitude the pilot is freed from the cabin and will fall freely to a predetermined altitude, where his parachute will be opened by a pressure capsule operated rip cord (see illustration).

Data for the design of the XS-1 was obtained from scale model tests in newly constructed supersonic wind tunnels using a heavy gas as the working medium. Velocities of 2200 mph have been reported from the tests. Converted to equivalent air speeds this represents 4500 mhp or approximately six times the speed of sound. The XS-1 has been towed into the air and tested by diving at 350 mph from 13,000 ft alititude. It now is ready for the first test flight under its own power.

Automatic Flight Controller

AAF's answer to the all-weather flying problem, the "push-button" C-54, fully automatic Douglas Skymaster, was developed by the All-Weather Flying Center engineers. The plane is operated by a device known as the automatic flight controller. Used in conjunction with the A-12 automatic pilot, the controller is described as a coordinated system of aircraft controls whose functions can be preselected to produce a desired point-to-point flight, including automatic take-off and landing. Thus it is possible with the automatic flight controller, after taxiing into take-off position at Wright Field, to press a button marked La Guardia Field and without further manipulation of any controls the plane will take off, climb to predetermined altitude, find and fly the preselected directional beams, arrive and land at the destination.

The nerve center of the automatic flight controller is the master sequence selector. To this are fed the variable factors such as direction, distance and altitude—much as numbers are fed to a calculating machine—and the master sequence selector then delivers impulses motivating in proper sequence the mechanical functions of the airplane.

Preparation of the plane for fully automatic flight consists of placing the plane in position on the runway heading with brakes locked and engine idling. Then the only manual operation is performed, a push of the button which activates the flight controller. That unit then takes over completely all direction and operation of the plane. Take-off is initiated by automatic move-up of the throttle, the brakes are unlocked after eight seconds, and the aircraft rolls down the runway for the take-off.

At 800 ft above the ground a pressurestat operates to retard the throttle, the wheels are retracted and flaps raised automatically, and the aircraft climbs to cruising altitude. At the predesignated cruising altitude the pressurestat again adjusts the throttle to cruising speed, the magnetic heading control is cut in, an air log starts counting air miles, the plane heads in the correct direction, and the automatic altitude controls cut in.

Upon approach to destination, signalled when the air log runs down, the auto-pilot homes on the selected radio compass station. Upon passing over a cone of silence marker the throttle is automatically cut back, with the automatic pilot being controlled by a compass locator station at an outer marker, a down signal is fed into the elevator control circuit, and the aircraft begins to let down. Upon reaching an altitude of 880 ft, the pressurestat initiates the automatic operations to lower landing gear and flaps, cut back the throttles, and cut in automatic altitude control, with the aircraft still homing on the locator station. As the aircraft passes the outer beacon marker the elevator control is operated and the plane moves into the glide path. Upon touching the runway the throttle automatically cuts back and the brakes are applied automatically after an interval of three seconds. Ground direction is controlled by differential braking until the aircraft comes to a full stop.

Why Car Costs Are Higher

(*Continued from page* 17)

items such as nuts and bolts. With the supply of cadmium for an anti-corrosion coating short, Ford has turned to zinc plating at greater cost. In addition, more difficulty is experienced in getting a good coating job, requiring careful attention to cleaning the parts to be plated. Another problem Ford licked at heavy expense was that of getting a satisfactory bond between metal and the synthetic rubber moldings used around the windshield and windows. It was found necessary to use Neoprene glue, one of the most expensive synthetic glues on the market.

Government directives also have worked some mischief with materials needed by the automotive industry. One example is pig iron, much of which has been diverted by Government fiat into the housing and agricultural fields. George Christopher, president of Packard, said a few weeks ago that the diversion has exhausted the company's stockpile of pig iron and that enough was available to run at only six per cent of capacity. He said that one source in Utah, where pig iron was available at a premium of $15 a ton, has had its output allocated to the West Coast program. Another agency that is hampering automotive production is UNRRA, whose purchasing program has caused a shortage of corn starch. Cereal binders are used in foundry cores in the manufacture of automotive castings. One enterprising company sent a purchasing agent out into the country where he scoured up four carloads of corn directly from farmers for shipment to a processer who then supplied the badly needed binder.

With supplies on a hand-to-mouth basis, many extra costs are incurred in transporting parts and materials to the assembly plants. In one instance, Nash used air freight to keep front wheel spindles flowing into the assembly lines from a new source on the East Coast when established suppliers were strike-bound. Ford also has used air freight to ship steel spring wire to assembly plants. The cost in both cases was several times what rail rates would have been. With no backlogs built up on many items, it often is necessary to ship in small lots and even to dispatch special messengers to pick up a small consignment of parts which are holding up the assembly line, adding greatly to the cost of doing business.

Even with the improved outlook for production in the weeks ahead, the prospects now are for a continuation of the plague of shortages for many weeks. Pig iron is considered by some companies as the most serious. Purchasing agents list steel, copper, zinc, and lead all as potential trouble spots. And although supplier strikes are definitely on the wane, there is the ever present possibility that a major vendor may be closed and with the close integration of the industry, one large stoppage could shut down one or more companies. In fact, Studebaker was forced to suspend operations on passenger cars July 19 because of a strike at Electric Auto-Lite Co., which supplies electrical equipment for cars.

Detrex Corp. Moves to New Address

Detrex Corp. has moved its administrative and plant headquarters to 14331 Woodrow Wilson Ave., Detroit. All mail and operational matters should be referred to Box 501, Roosevelt Park Annex, Detroit 32, Mich.

General Requirements for Helicopter Engines

(*Continued from page* 44)

jet and distribute it into the air. Even mixture distribution is necessary in any engine, not only from an economical standpoint, but also from a cooling standpoint. If one cylinder is running lean, it will, of course, run hot under continuous full-throttle operation. If the carburetor is enriched to take care of the lean cylinders, then all other cylinders will operate under an overly-rich condition. Repositioning of the jet, in some cases, has straightened out the distribution so there is only one ratio difference between cylinders.

Fuel injection has certain definite advantages since it generally gives much better mixture distribution, thus reducing high cylinder temperatures resulting from a lean condition. In the development of a 240 hp engine it has been found that if good mixture distribution exists, it is possible to cool the engine at rated power with four in. of water, maintaining an average cylinder head gasket temperature of 400 deg. in 100 F. air. On the other hand, if a cylinder is on the lean side by a matter of two ratios, its temperature may increase to 525 F., creating detonation problems.

The use of aluminum cylinder heads in air-cooled engines has long been common practice, but the use of a one-piece aluminum cylinder has been often tried and often condemned. Experience with a satisfactory single-piece cylinder has shown that it is necessary to have 0.012 to 0.016 in. liner shrink on a 4¾ in. bore cylinder. Then the liner expands more or less with the aluminum which surrounds it. The use of a unit aluminum cylinder with cast fins has saved approximately 20 lb. in a six-cylinder engine. Carrying this type of design still further, machining the fins on the barrel portion of the cylinder and the cast fins on the upper end of the cylinder, has resulted in a 40 lb. saving in the six-cylinder engine. At the same time the cooling ability of the cylinder has vastly surpassed that of the all-cast fin cylinder. In order to save weight in the cylinder a very thin liner has been used. The most satisfactory liner to date has been a cast ferrous type having approximately 0.5 per cent chrome and 0.5 per cent nickel. When this liner is machined to size in the cylinder it is 0.035 to 0.040 in. thick. However, experience has shown that the thickness of the liner is not too important, provided it is shrunk onto the cylinder with a 0.012 to 0.016 in. fit, as mentioned above. There is a possibility that developments will be carried to a point where it will not be necessary to use a liner in the cylinder other than a chrome-plated surface directly on the aluminum. The experience thus far with this type of plated liner and aluminum cylinder has been somewhat erratic—some have operated very satisfactory and some have failed in a comparatively short number of hours because the chrome plating separated from the aluminum.

Good results have been obtained by running the piston rings directly in the aluminum cylinder itself, provided the piston skirt is chrome plated and the rings themselves are chrome plated. It is necessary for satisfactory operation that the piston clearance be a minimum of approximately 0.003 to 0.005 in. and the edges of the piston rings be rounded well in order to eliminate any possibility of the ring cutting into the cylinder itself. The first few minutes of operation are the most critical of the run-in, and once past the early stages of the run-in, the aluminum surface becomes hardened by the piston rings and wear is reduced to a minimum. The decrease in wear may be due to the fact that the water vapor, resulting from the cylinder explosion, does not corrode the aluminum.

Abstracted from a paper presented at the SAE

Timken's Proving Ground

(*Continued from page* 28)

ing identification is stamped on the back surface in an adjacent Bliss press and given another pass in the Blanchard to smooth the surface.

The basically new operation is that of turning the race to grinding tolerance and finish in a two-spindle Heald Bore-Matic fitted with massive single-point tools tipped with steel-cutting grade Carboloy. This operation finishes the OD and the radius, holding the OD to plus or minus 0.0005 in.

The work then goes to another Heald Bore-Matic in which the work is chucked for precision-boring the ID, two chamfers, and front face radius in one setting. The races then are transported to the main plant for heat treatment.

Upon returning from heat treatment, the races again are surface ground in the Blanchard; the OD is finished in a No. 3 Cincinnati Centerless grinder fitted with magazine feed; and the ID finish-ground in a No. 81 Heald internal centerless grinder.

The ID is then honed to a superfinish in a Timken two-head honing machine provided with hydraulic feed mechanism. The finished parts are washed in a Detrex washer, using a soluble oil mixture to provide rust-proofness. The final operation is visual and dimensional inspection.

Use of color in painting the equipment in this small plant offers the final touch of modernity. The body of the machines and other equipment is painted in a pleasant green while fixtures and accessories are finished in a bright orange. We have given considerable space to this operation because it is unusual in industry and offers a pattern which may be of more than passing value to other manufacturers.

The Darrin Car

(*Continued from page* 34)

The front seat frames are tubular construction, using sponge rubber and flat springs. A 60 in. seat width gives ample capacity for three passengers. The rear seat of the convertible is built for two passengers and is 45 in. wide. The front seat is moved forward by a hydraulic actuator, making the rear seat accessible.

Seats and interior upholstery are the same material as used in the convertible top—a soft plastic with the appearance of leather and possessing great resilience and weathering qualities. A variety of colors will be offered.

Hydraulic systems are installed for raising and lowering door windows, engine hood, convertible top, convertible top rear window, adjusting the front seat. The car is also jacked hydraulically. One jack on either side will raise the front and rear wheels on that side almost simultaneously, due to the rigidity of the chassis. All hydraulic units are controlled by the driver through solenoid switches and valves.

The rear license panel is flush with the body and hinged so that when pulled open, door fashion, the fuel tank filler tube is revealed. The bumper of the Darrin is the "wrap around" type. A stainless steel grille is used. Top lights are Hall Lamp Co. standard sealed beam. Fog and parking lights are combined in a panel just below the top lights.

The electrical system of the car is a standard 6 volt, Auto-Lite. Brakes are hydraulic, 10 in. diameter by 2 in. The wheels are steel disks with widebase 15 in. rims. Tires are 6.00-15.

Road testing of the car was done by A. L. Nelson, chief engineer, Hayes Manufacturing Co.

Advertising Note

Burton Browne Advertising of Chicago has been appointed as agency to assist in the development of new advertising and merchandising campaigns for Littlefuse, Inc., Chicago, Ill.

Wage Incentives

(*Continued from page* 19)

the most necessary "human relations" groundwork for the plan.

General union attitude toward wage incentives needs some mention here. Will the union play ball? If this question had been asked a few years back, the answer would have been a ringing "no!" Then high-pressure "efficiency experts" gave incentives a luminous black eye by installing so-called "treadmill" systems in which workers shared less and less for more and more work. But today's incentive gives the employe a "fair shake" on savings incurred through his increased production.

Thus, it can be safely stated that the average union local will play ball when a new incentive is introduced in the plant or when a plan which has become outmoded is re-engineered in the interests of efficiency and objectivity. It is true that some union officers are today giving lip-service to the slogan "abolish wage incentives as a worker strait-jacket." Such remarks, however, must be discounted. The Labor Relations Institute experience at grass-root levels has clearly demonstrated that workers are more than eager for the extra earnings made possible by incentives. And unions have already seen what wage incentives can do to improve a worker's pocketbook. These would like nothing better (for the sake of prestige alone) than to keep workers' wages as close to the high wartime level as possible.

Now some words on the proper procedure for "selling" a wage incentive plan to workers before the engineering gets to work. It is important to eradicate all doubts and suspicion likely to lurk in the backs of workers' minds when the words "wage incentive" make their first impact. The company must be thoroughly prepared well in advance to answer all questions about the plan. Moreover, an intensive plant-wide program should be put into effect to keep employes informed. Employe newspapers, special explanatory booklets, and charts, payroll stuffers and personal letters mailed to workers' homes—these and other methods all can be used to good effect.

This procedure is doubly important today, since nearly all companies have granted substantial wage increases. Should the company announce its intention to put in some new "gadget" at this time without taking the trouble to "sell" the workers, there is no doubt that organized and unorganized workers alike will interpret this move as part of a clever plan on the part of management to play "Indian Giver" on wage increases already granted.

First quite natural reaction of any worker upon the announcement of a wage incentive plan is fear—fear over lower wages, fear over insecurity

(*Turn to page* 70, *please*)

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through change, fear that he won't come up to the new standards. Fear over the speed-up effects of wage incentives, which was a strong tub-thumping argument by unions in the past, has now been largely eliminated. The familiarity which workers generally have experienced with soundly-engineered incentives has tended to eliminate most opposition from this source in recent years.

Still and all, management must take nothing for granted. Here are some practical moves by management to overcome union and worker suspicions about incentives, new or modified:

1. *Count the union "in."* Tell the union officials why it's necessary to make new time studies and establish new rates. Show them how the company's business has been affected by competition from other companies whose workers are paid less or are apparently more productive. Point out how certain incentive rates have become unbalanced if this is actually the case. A general heart-to-heart talk, the Institute has found by experience, helps overcome most union resistance and many times provides some good ideas with practical value to management.

2. *Submit plan in writing.* The entire plan should be submitted in writing to the workers. This will avoid any charges of "false promises" and will nip any plant rumors built on sour grapes. The institute's engineers have found that the printed word is effective with workers if it is made interesting in its presentation. Question-and-answer leaflets usually hit home best. But be sure that the foreman explains how the worker's earnings will be affected by the plan. At all times use the foreman as your "follow-through."

3. *As last resort, allow trial period.* Generally speaking, trial periods should be avoided. A well-engineered incentive system needs no trial period and is usually geared to a more long-range period rather than to a short-run phase. However, where union and workers prove especially adamant in refusing to cooperate, show your willingness to go more than half way by suggesting a 90-day trial period. This will usually "clinch" worker cooperation.

4. *Allow for grievance handling.* Adequate provision should be made for adjusting grievances over rates or standards. A sounding board for inequities or misunderstandings should be a part of all incentive plans. If there's a union agreement, the following well-tested clause is made to order:

"The employer will continue to set incentive rates. It is agreed that any dispute over such rates may be taken up through the regular grievance procedure. Any agreed upon adjustment in incentive rates should be retroactive to the date the grievance has been filed."

The following is an actual case of a company which refused to provide such a "safety valve" for adjusting grievances. In one automotive company, union men were trained in time study at company expenses. The sound training these men received, however, proved of little avail when individual workers began to complain that the standards set were too high. Thereafter, the union time stewards came to feel that they were being squeezed between their responsibilities to management and their loyalty to the union. The plan that had been correctly installed began to falter. Negotiations did no good—and the plan soon had to be revised at needless expense and time.

5. *Allow for later changes.* The incentive plan should be formulated to enable management to make necessary changes. Union or no union, the plan must have flexibility. If strapped up in a strait-jacket, it may prove costly. For that reason, too many details of the plan need not be included in the union contract. Stick to general clauses.

6. *Don't give union too much rope.* Giving the union too much rope will strangle the incentive system before it gets started. It's true that unions should be brought into the spirit of things—but they should not be arbitrary judges. Proposed rate changes

(*Turn to page 74, please*)

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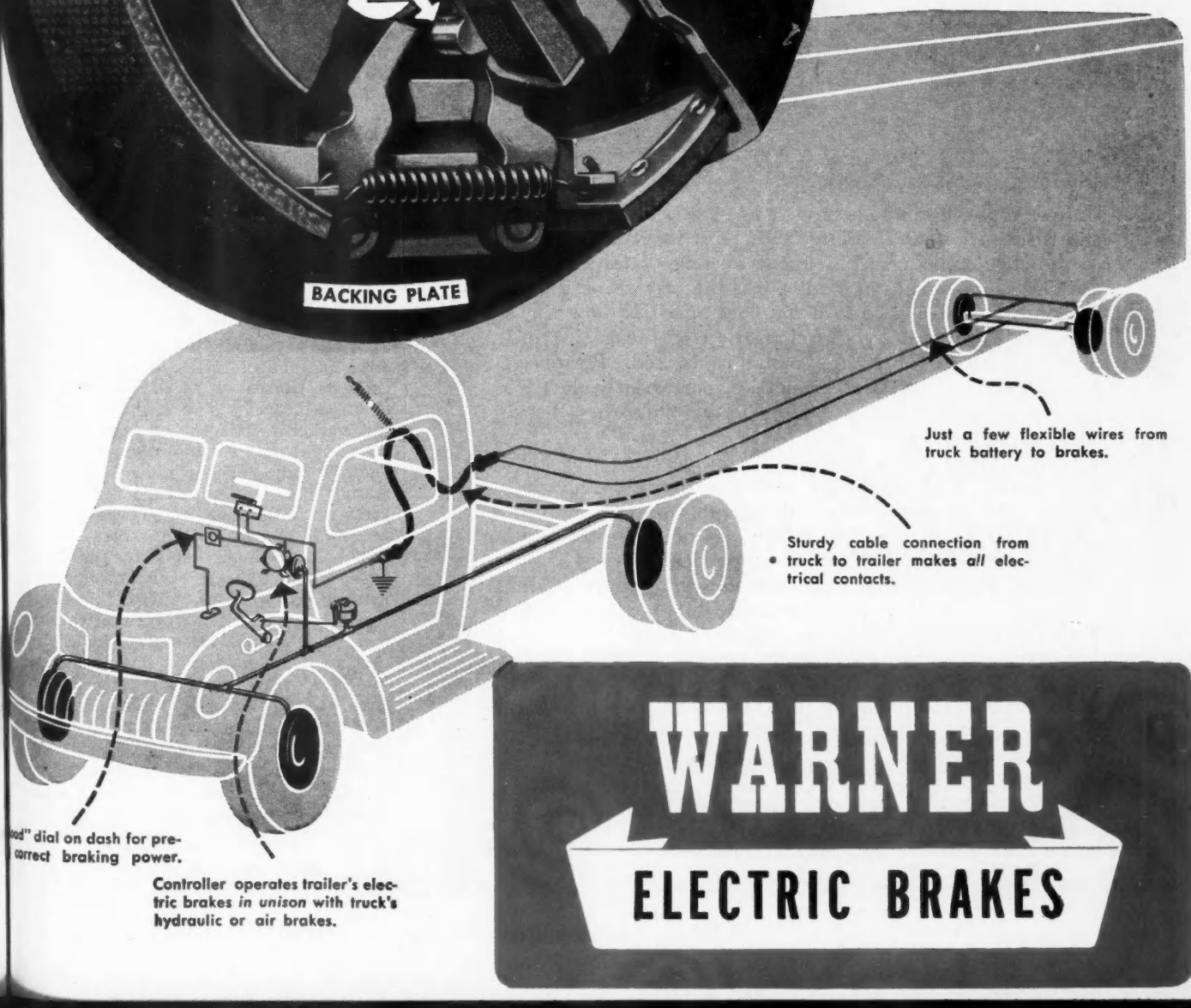

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should be submitted to union officials before they go to workers. Suggestions should always be encouraged. But no sweeping changes should be permitted.

7. *Allow for lost time.* One of the more serious common errors made by management, the Institute has discovered, is that no provision is made for compensation when workers must wait for materials, stand by while machines are being fixed, or take time out for natural needs and other contingencies.

Unions have been especially loud in their complaints about workers suffering financial loss for reasons beyond their control. Employe morale will suffer severely if an incentive plan bogs down due to poor maintenance set-up or flow of materials. A short clause in the contract is sufficient to cover this point.

After these labor relations problems are thoroughly worked out well in advance, management in the automotive and aviation industries must ponder carefully the pros and cons of the wage incentive plan to adopt or to substitute when the old one cracks at the seams.

The average company will always find that the services of outside management engineering consultants are advisable at this stage. It is important to point out that the incentive system will never be a sure-fire cost-cutting technique unless it is properly installed by experts. Each plan, moreover, must be carefully ground to the individual plant's need and, once installed, closely supervised for any eventuality.

In general, incentive plans fall in three categories — plant-wide, group and individual. Plant-wide incentives, although used widely during the war, have been demonstrated to be generally unsound. Individual incentives are preferable wherever possible, but in many automotive assembly line operations group rates are unavoidable.

When properly installed, a group incentive plan will result in improved teamwork. It is also much easier to compute employee earnings under group plans than under some types of individual incentive. An illustration of how group incentives may be calculated is provided by a stamping department which has an average weekly ouptut of 4000 units.

If the same workforce of employes produced 4400 units a week, the workers would receive a 10 per cent bonus above their base pay. If 4800 units are produced, a 20 per cent bonus would be paid to the participating personnel. This, of course, is a simplification of the group incentive plan.

Disadvantages which may arise under group incentives are rivalry and jealousy between departments, groups and shifts. Friction may also develop in the group if some workers criticize those who are unable to keep up with the team.

Labor Relations Institute's experience with hundreds of incentive plans has shown that the individual incentives are by far the most productive and most satisfactory in the long run. Most automotive company plans fall under the individual category.

The straight piece work plan is today the most widely used of all individual incentive systems in the automotive field. Although it is the simplest, in some respects it is the most difficult to install properly. Experience has shown that one of the most common causes of the failure of the average incentive plan is the failure of the worker to understand how his pay is computed. Furthermore, he frequently may not know even approximately what he has earned for his efforts until the end of the week, when he gets his pay. That is too late.

The advantage of straight-piece rates is that the worker knows from hour to hour just how much he is earning. Every time your average worker, John Doe, stamps out a part, he knows that under a piece rate, he can say to himself, "Here goes one for John." And he will know to the penny just how much that is. This obviously makes for extra effort.

Standards and rates must be set by careful study under individual incentives just as under all other types of incentive systems. Piece rates are not easily adopted where work is inter-

(*Turn to page 76, please*)

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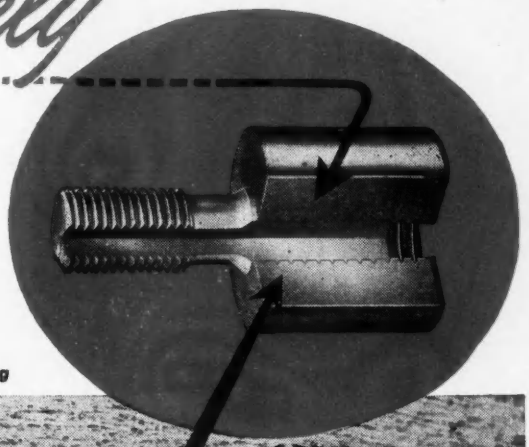

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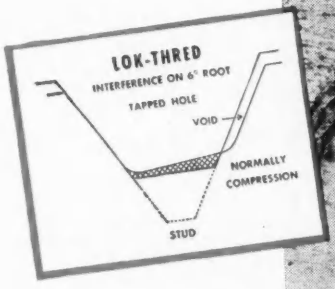
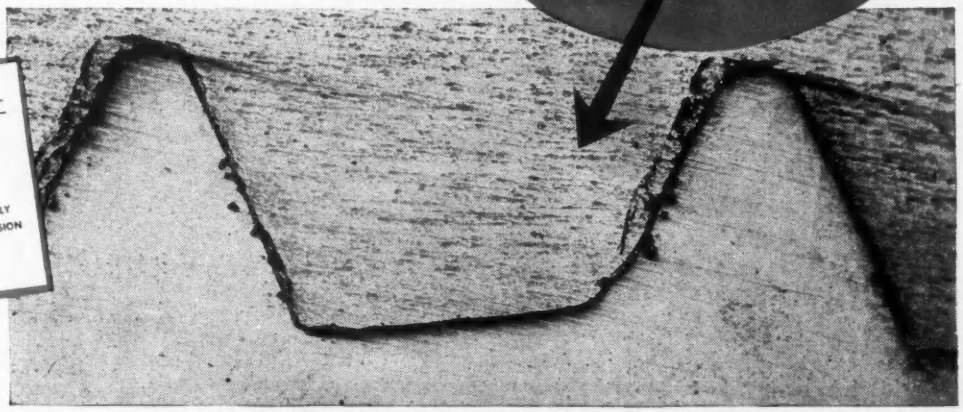
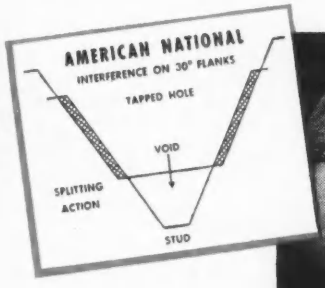
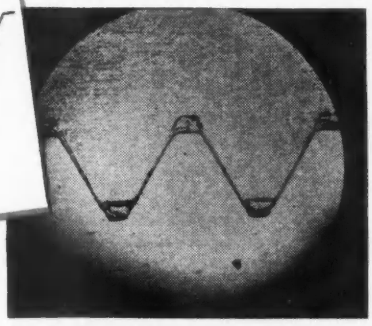




Photomicrograph of thread section in place in aluminum, showing how 6° root angle in Lok-Thred design absorbs the load.





Photomicrograph of conventional stud thread (oversize fit in an attempt to lock).

Here's an entirely new principle of thread design—the LOK-THRED!

In conventional threads, stresses result in shearing or stripping action borne by the thread flanks.

The LOK-THRED design puts the load on the 6° angle at the root of the thread so that stresses are carried by compression transmitted to the surrounding metal.

The LOK-THRED is especially suited to studs for use in aluminum and magnesium as well as cast iron or steel. It solves the designer's age-old headache of studs loosening under vibration or lateral motion.

National HEADED AND THREADED PRODUCTS

FACTS ABOUT LOK-THRED

1. A modified American National thread designed to lock securely and become tighter in service.
2. Handled with standard tools.
3. Does not require selective fits.
4. Seals positively and in many cases obviates need for blind tapping and adding bosses.
5. Has much higher fatigue limit than ordinary threads.
6. Does not gall when being driven.
7. Does not fret from lateral motion.
8. Entire normal working load carried on 6° angle at root of thread.
9. Stronger in both tension and torsion than ordinary American National threads.
10. Re-usable and on any re-application one additional quarter turn brings the torque back to its original installation value.

Write for samples and full information

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

mittent. Careful inspection is often essential. Despite the fact that some types of incentive are more complicated they may have special advantages which makes them suitable under certain conditions. It is possible to sell them to workers, but care must be taken at all times to see that the individual worker understands the basis of pay, and can therefore relate it to his effort.

There are many variations of the individual incentive systems and here are some types in wide use:

1. *Production of selective incentives:* These remunerate workers for producing above a certain standard. The Taylor Differential piece rate plan is one of the best known of this type. Two piece rates are provided, one for superior performance and the other for subnormal performance. Detailed timing of each step is necessary.

2. *Time-saving incentives*: Such incentives are based on the amount of time saved by employes in producing a complete unit.

The Halsey-Rowan gain-sharing plan falls under this category. It provides for an hourly rate as well as a premium piece rate. Employes who produce at or below the standard output receive a minimum weekly wage. More proficient workers are compensated for time saved at from 30 per cent to 50 per cent of the payment for time taken. Past performance can sometimes be substituted for scientific time studies.

The Standard-Hour plan is more flexible and compensates employes in full for time saved. A guaranteed hourly or weekly rate is provided, and over and above that amount the employe is credited with the number of standard hours that his output represents. This plan is particularly suitable in processes where the employe is called upon to shift from one task to another. The Gantt Task and Bonus System depends upon the accurate selection of a standard that is somewhat above normal production. Those unable to come up to the standard are paid only straight time rates, while superior workers are compensated fully at regular piece rates plus a 20 per cent premium on such rates. This provides a sharp differentiation between better and inferior workers. The plan easily lends itself for use as a foreman incentive system.

Other plans similar to the Gantt are the Baum Differential Plan and the Diemer Bonus and Premium Plan.

3. *Interdepartmental Incentives*: Such plans are geared to operate continuously regardless of employe transfers. The time required to do each job in the factory is determined by time studies.

The Bedaux Plan and Haynes-Manit Plan fall under this category. Under the Bedeaux plan, a point is allotted for each minute of the time required to do the job. An 8-hour day is figured as 980 points. The number of standard points allowed for each job is

(*Turn to page 78, please*)

shown on the individual employe's work ticket. The value of each point is the hourly rate divided by 60. Under this plan, 75 per cent of the savings go to labor.

In calculating daily incentive earnings, the number of points allowed for each job completed is totaled. From this total, the number of points in the standard 8-hour day is deducted. The resultant figure is multiplied by the minute pay value of the employe's points.

Measured Day Work Plan also falls under this category. The employe is paid a pre-established amount per hour if he attains the minimum production standard management has set for the job. Merit rating is injected into this plan, since the worker is paid not only on quantity of output, but on quality of work, his dependability on the job, and his versatility in handling a variety of tasks.

All of the above plans have features that have strongly recommended them to individual employers. They have been made to work successfully. Yet all have pitfalls into which the plan can be plunged. Some encounter more opposition from workers at the outset. Some will work smoothly in one plant, and will bog down hopelessly in another. That is why each incentive plan must be selected and tailored to fit the individual plant's manufacturing and personnel problems.

It is not always easy to predict from what source trouble will arise, although the management engineer, who has established dozens of plans, will have a wealth of experience to draw upon in avoiding problems which have unexpectedly developed in recent years. Establishment of the selected plan is relatively easy; it is the administration of it, the adaption of it to fit individual work problems that requires unremitting attention and effort on the part of the employer. Here are some typical plans in the automotive industry:

Company A: This plant makes auto parts and uses a plan which is a combination of straight piece work and group bonus. Group bonuses are particularly applicable to assembly work, while machine work is paid on a piece work basis. A base rate is set at levels equal to those paid in that area. Standards are set by time study. Payment is not made for parts spoiled due to workers' carelessness. The soundness of this plan is demonstrated by the fact that it has been in continuous use for over 20 years.

Company B: This plan calls for the establishment of piece work standards, so that average worker using normal effort will make a bonus of about 25 per cent. The company adopted this piece work plan after it had unsuccessfully tried more complicated bonus systems.

Company C: This automobile manufacturer pays group rates to assembly line operations. Payment is based either on number of cars assembled or on a straight hourly basis. If the group meets its quota, individual earnings will be slightly higher than if they were computed on the alternative hourly basis. Individual piece rates are evaluated on the same alternative basis. This plan is calculated to assure adequate incentives for smooth and even production. Sharp gains in productivity are not sought.

Company D: This incentive plan is based on company-wide bonuses over and above individual piece rates. Workers are paid the bonus at the end of the year, on the basis of individual piece work rate, length of service, overall record, etc. The plan contributes to reduced absenteeism and has numerous other advantages, but it is probably applicable only to plants which have no union.

Advertising Notes

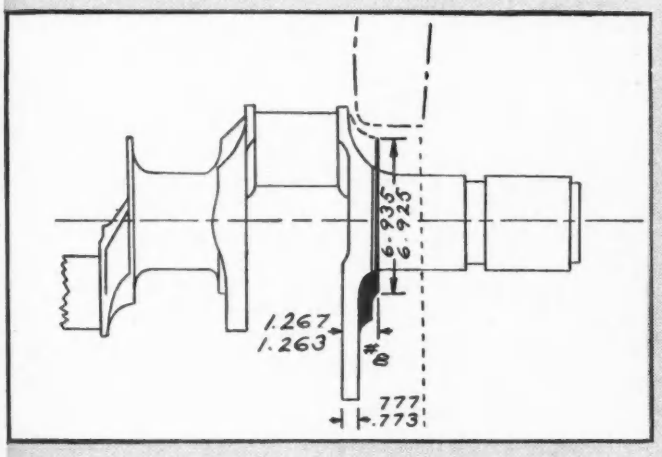
Following the recent announcement that the Truckstell Co. will distribute Columbia axles for passenger cars, Ross Roy, Inc., of Detroit has been named to direct the advertising of the Columbia Axle Co.

John P. Gaty, vice-president and general manager at Beech Aircraft Corp. of Wichita, Kan., has announced the appointment of Erwin, Wasey & Co. as Beechcraft's advertising agency.

ONE GRINDING OPERATION *Eliminated* BY A MODIFIED STANDARD MACHINE

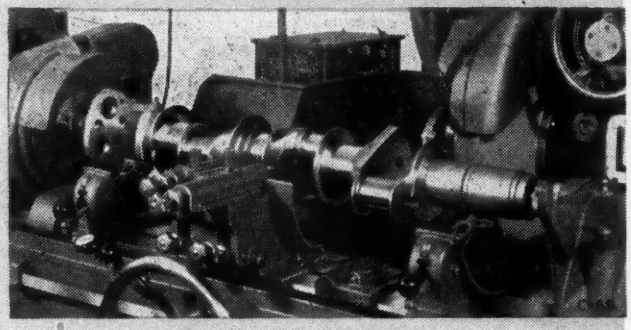
THE PROBLEM

To speed up production of airplane engines to meet wartime demands by reducing grinding time of certain crankshaft fillets. Two operations were necessary with manual feed.



THE SOLUTION

Starting with a standard machine use was first made of the maximum angle at which the wheel-base could be set without interfering with the work. This was only 4°. This small angle together with a formed wheel made possible plunge grinding of the fillet. The addition of Landis Tool hydraulic rapid infeed still further speeded the grinding and eliminated manual feed.



For maximum strength crankshafts of aircraft engines must have fillets and these had to be ground to close tolerances.

Landis Tool engineers were called in when a production problem was created by the demand of the armed services for more airplane engines. Starting with a standard machine—modifications were made that cut grinding time in half with a resulting increase in crankshaft production.

Your grinding problem may involve larger or smaller parts, but you can depend on the simplest and lowest cost solution. Our engineers are available to help you solve your grinding problems—call on them.

37

LANDIS TOOL *Company*

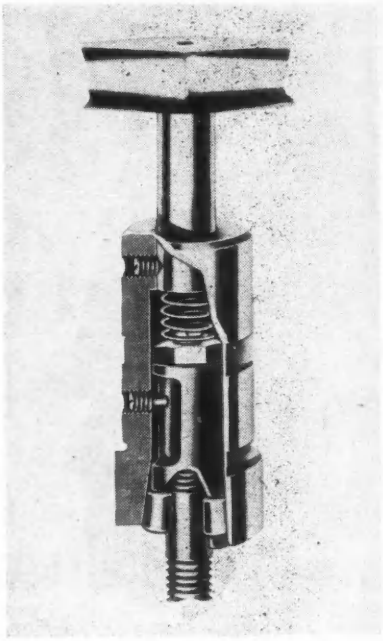
WAYNESBORO, PA.

New Production Equipment

(*Continued from page* 43)

Where a power tool is desired, the only restriction applying is that the motive power used must have a means of being brought to an abrupt stop when the stud has been brought to the proper depth. The T-handle, ratchet, or power tools are made in standard sizes from 3/16 in. to 1 in. inclusive—larger sizes on request.

A FRESH AIR, safety welding booth is being planned for future production by the Hobart Brothers Co., Hobart Square, Troy, Ohio. The booth will be 9½ ft. wide, 9¼ ft. deep and 7 ft. high. It is to be constructed of fabricated panels of 16 ga. sheet steel formed with companion flanges, punched on 12-in. centers for bolting assembly. This type construction is said to make it easy to disassemble the unit to move to another location if desired. The door is sliding type with overhead track and easy running rollers, and measures 43 in. wide by 78 in. high.

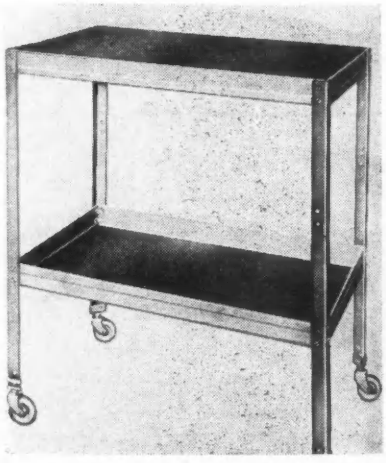


Titan-Kirkland combination stud driver.

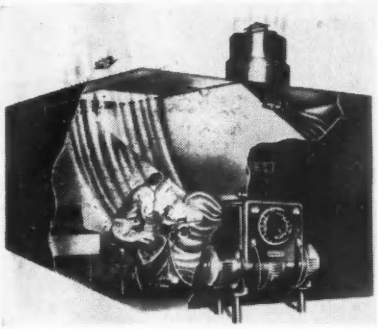
The heavy duty exhaust fan draws in air through an opening in the top, down past the operator to pick up welding fumes and heat, and then expells it to the outside of the building.

(*Turn to page* 85, *please*)

Tool and Work Stand



Made with heavy gage steel shelves and heavy angle iron legs, these tool and work stands fill many requirements such as parts and tool containers and transporters, tool and work stands in conjunction with operating equipment, assembly line parts containers, carrying portable inspection equipment on assembly lines or stock pickup and transportation. They are finished in olive green baked enamel. The new stands are 30 in. long and 18 in. wide. When furnished with casters their height is 33½ in. and without casters they are 30 in. high. Manufactured by Bay Inc., 1553 Indiana Ave., Philadelphia 32, Pa.



Hobart fresh air safety welding booth.

In this manner, this booth serves a double purpose in providing fresh air and comfort to the welding operator, and at the same time protects fellow-workers in other parts of the plant from eye burn and welding fumes.

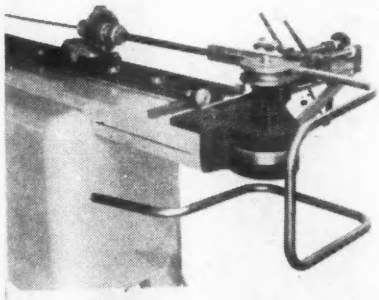
AUTOMATIC TRANSPORTATION CO., 149 W. 87th St., Chicago 20, Ill., offers a new material handling unit, the Transtacker, which does the work of a fork-lift or high-lift platform truck where weight, size, speed or cost make the larger unit impractical.

Shown in the illustration is the platform model, for use with skid platforms, one of four Transtackers available. The other three models are fork models built for all types of pallets. The platform model will handle loads up to 4,000 lb. and will raise them 68 in. Weight of this model is only 1,900 lb.

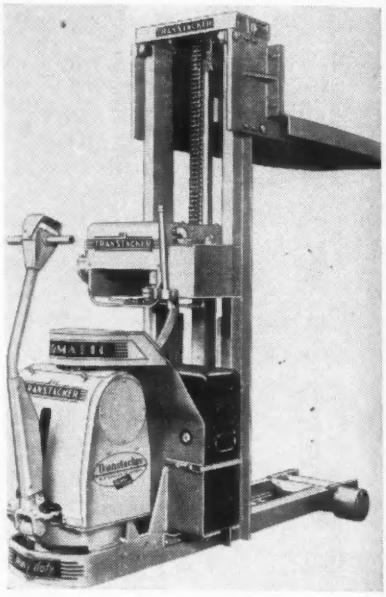
The Transtacker's lift mechanism is said to have all the advantages of regular lift trucks. It features a new hydraulic system and the same oversized pump and motor. It is built on the

(*Turn to page* 86, *please*)

Leonard-Douglas Bendmaster



This new model, with a capacity of 3/8 in. to 1½ in. ferrous or nonferrous tubing, is hydraulically operated. From one to 10 bends may be made in a single length of tubing with only one setting. The unit is designed for any production bending operations requiring multiple bends per tube and duplicate parts such as automotive and aircraft tubing. Manufactured by Leonard Precision Products Co., 1100 Larsen Ave., Garden Grove, Calif.



The Transtacker

chassis and drive unit of the Transporter, Automatic's motorized hand truck. It features the Transporter's finger-tip control which enables the operator to regulate direction, speed, lift and brake all with one hand.

A NEW vertical boring machine for precision rough and finish boring of large cylinders up to 40 in. in length and 6 in. to 8 in. in diameter is announced by Giern & Anholtt Tool Co., 1319 Mt. Elliott Avenue, Detroit 7, Mich.

The machine, identified as the TR model, is said to offer extreme rigidity and accuracy with the spindle piloted directly above the work in a Gatco sealed rotary bushing. It is equipped to bore cast iron, steel or non-ferrous

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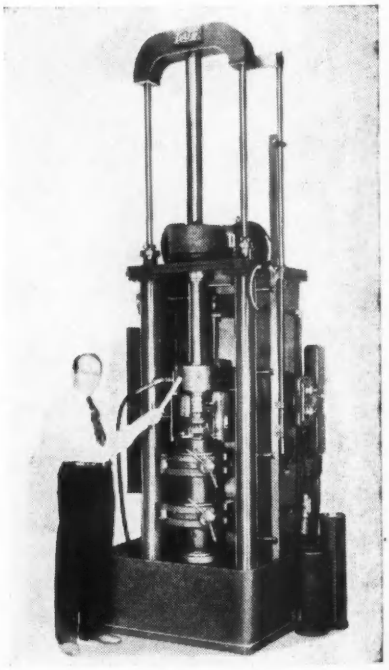


Giern & Anholtt boring machine

Cutting Tool Engineering

To do production work on metal parts *economically* these multi-operation tools are an unequalled help. By combining several operations they are *faster*, by insuring perfect concentricity between diameters they hold consistently to close tolerances.

Designed with either inserted blades or flutes independent of each other and carefully proportioned, the length of each cutting edge is easily maintained.

GAIRING'S *Cutting Tool Engineering* developed the tools of which examples are shown here. If you too can use our services get acquainted. Write for our condensed catalog or our comprehensive catalog which gives complete descriptions of all our products.

THE GAIRING TOOL COMPANY, Detroit 32, Michigan

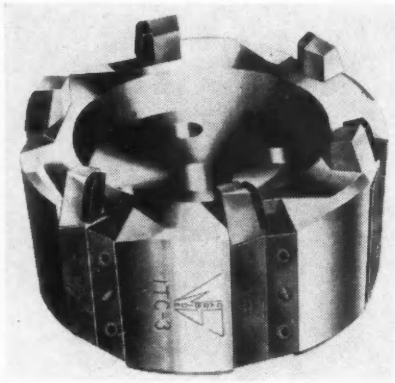
GAIRING TOOLS

MANUFACTURERS OF STANDARD AND OF SPECIAL PRODUCTION CUTTING TOOLS

tubes using a multiple blade boring cutter.

The Model TR is completely hydraulically operated and has a feed on 8-in. ID tubing of 4 in. per minute in roughing and 4½ in. to 5 in. in finishing. The power requirement on the operation is approximately 10 hp.

A NEW inserted-tooth carbide cutter, with blades interchangeable for any type of milling job, is being introduced by the Wendt-Sonis Co., Hannibal, Mo. The cutter is said by the manufacturer to require less power than ordinary cutters. It is readily adaptable to standard machinery.



Wendt-Sonis inserted-tooth carbide cutter

The new cutter has an added safety feature in the special type wedge which prevents blades from slipping out while in operation. When blades need sharpening, they may be easily removed from the cutter body and ground on an ordinary bench grinder. No special equipment is required.

ENESAY TOOL CO., 2240 Sepulveda Blvd., Los Angeles, Calif., has developed a new drill that is said to cut through intensely hard or very soft metals with equal facility. It readily drills through steel hardened to 68 Rockwell C, harder than file steel.

The new tool is designed for precision drilling and reaming to extremely

Enesay drill

close tolerances. The Enesay drill makes possible the salvage of steel parts after hardening, if errors or design changes have been made.

The drill is constructed of a new alloy which makes possible the penetration of hardened steel without impairing the metallurgical properties of the metal. Only the metal removed during drilling is softened, the surrounding metal remaining unaffected. The tensile strength of the drill is more than 45,000 psi.